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T. B. LITTLE, EDITOR

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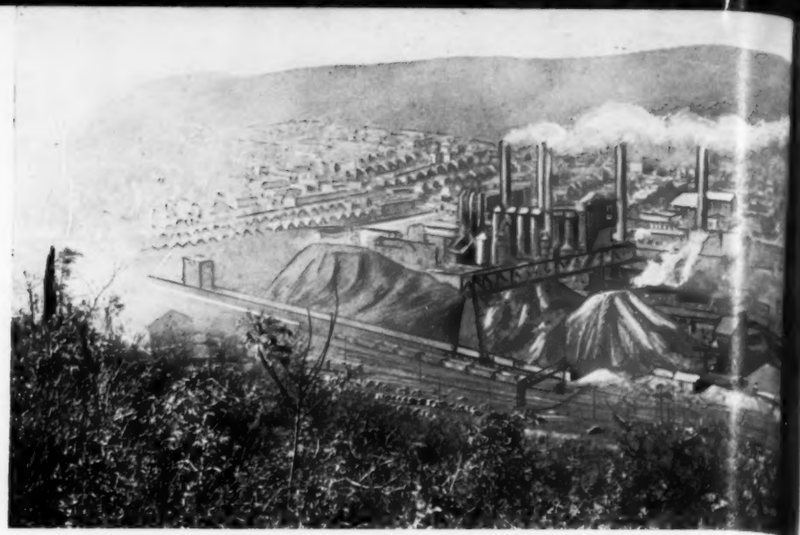
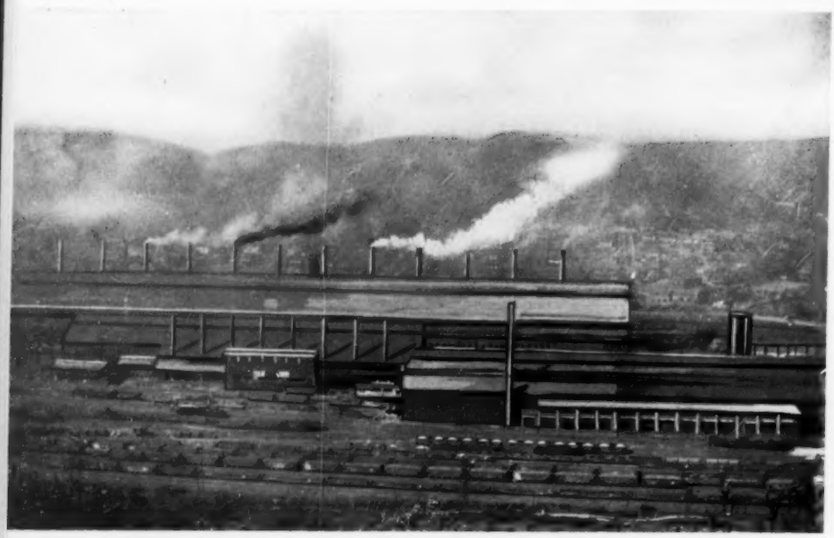
Tentative Convention Program



VIEW OF WEIRTON STEEL COMPANY WHERE THE INSPECTION TRIP WILL BE HELD



ANOTHER PARTIAL VIEW OF WEIRTON STEEL COMPANY

PITTSBURGH, PA.

SEPT. 24, 25, 26, 1935

WILLIAM PENN HOTEL

TUESDAY, SEPTEMBER 24th

Developments in the Iron and Steel Industry, 1934-35.

A Review of Sheet, Tin and Strip Mills.

Run-Out Table Motors and Generators for Hot Strip Mills

Industrial Relations

Material Handling in the Steel Industry

Power Requirements and Other Factors Pertaining to Rolling Hot and Cold Steel.

WEDNESDAY, SEPTEMBER 25th

Flat Rolling of Steel

Lubricants for Cold Rolling

Processing of Steel in the Finishing Departments

Manufacture and Use of Chilled Alloy Rolls

Inspection Trip to Weirton Steel Company, Weirton, W.Va.

THURSDAY, SEPTEMBER 26th

Insulation of Open Hearth Furnaces.

Oil Flooded Bearings for Roll Necks.

Welding with Alternating Current Arc.

Improvements in Pouring Molten Steel.

Steel Plant Lubrication.

Bright Annealing of Strip Steel.

Roof Temperature Control of Open Hearth Furnaces.

Oxy-Acetylene Welding in the Steel Industry.

Absorption of Steel in New Construction.

Some Applications of Controlled Atmosphere to Heating of Steel.

LL BE HELD

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Convention and Exposition

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Plans for the 31st convention and iron and steel exposition of the Association are rapidly nearing completion. As shown on the opposite page a very comprehensive technical program is being arranged. Authorities have been and are being secured to discuss all of these subjects. It is expected that there will be approximately thirty papers dealing with mechanical, electrical, lubrication, welding and combustion engineering subjects.

Along with these strictly technical subjects, the problem of industrial relations and distribution of steel will be discussed by leaders in these fields. On Wednesday afternoon, September 25, the Association will be guests of the Weirton Steel Company, Weirton, W. Va.

To be held simultaneously with the convention, the iron and steel exposition is shaping up in such form that it promises to be one of the most educational exhibits we have had in recent years. Approximately 90 manufacturers of steel mill equipment have reserved space which speaks well for the confidence the suppliers of equipment have in our exposition as a medium through which to contact the purchasers of their products.

Supplementing the efforts of the various committees in formulating the plans for the coming conference, has been the helpful attitude and willingness to co-operate of all the leading steel mill officials in the Pittsburgh district. With such expression of confidence in our organization every operating steel man in the country should leave nothing undone to guarantee his attendance for the three day convention on September 24, 25 and 26.

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THE DEVELOPMENTS IN THE DESIGN AND OPERATION OF OPEN HEARTH FURNACES

By R. S. BOWER
Open Hearth Supt., Corrigan-McKinney Steel Company, Cleveland, Ohio

Paper presented before the A. I. & S. E. E. Spring Engineering Conference held in Youngstown, Ohio, April 24 and 25, 1935.

The melting of steel in regenerative open hearth furnaces was first proposed by C. W. Siemens under specifications of his British letter Patent A.D. 1861.

This fundamental patent, as used with producer gas for heating is shown in Fig. 1. The furnace consists essentially of the melting hearth, a, and the regenerators, composed of a pair of chambers, bb, for gas, and a further pair of chambers cc, for air. All chambers are filled with a checker work of firebrick. The gas from producer main, A, enters the furnace through valve d to chamber b, ascends into the right hand side and above the hearth, where it is mixed with the air, introduced through B and valve e to chamber c and ignited. The flame produced pass over the hearth A, transmitting part of its heat to the material to be melted on the hearth. The waste gases pass into the chambers b and c, giving heat to the checker brick as they descend, and finally through valve d and e to the stack C. When the checkers have reached their thermal saturation, the valves d and e are set in positions shown by broken lines, so that the current of air, gas and waste gas is reversed as shown by broken line arrows. The incoming air and gas now take up the

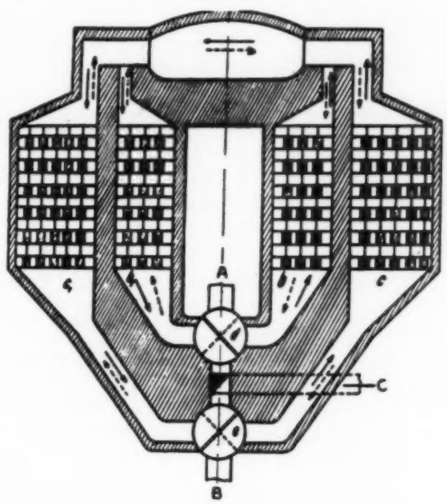


FIG. 1

heat stored in the chambers and enter the hearth at higher temperature. The waste gases give their heat to the outgoing checkers. Thus with periodically reversing valves, alternate heat charge and discharge of the chambers take place.

For the past seventy-four years this regenerative principle has not changed and it is my belief that the regenerative or open hearth furnace will make the larger portion of our steel requirements for a good many years to come. Details of construction and design and operations have changed as the furnaces have increased in size from two tons to three hundred tons or more.

R. S. BOWER

The first open hearth furnace on record as a commercial process was built by Messrs. Piere and Emil Martin at their Sireuil works in 1864 under license from Siemens. This furnace was chiefly intended for a heating furnace, but was so constructed of silica brick that it could be used as a melting furnace. The experiments of the Messrs. Martins were quite successful and soon created a great deal of in-

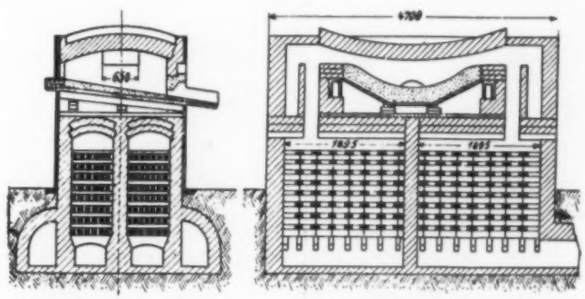


FIG. 2

terest throughout the metallurgical world. Figure 2 shows this furnace at Sireuil with a capacity of two tons. The gas was made in a Siemens inclined grate gas producer. The air and gas regenerators were of

equal volume and the air and gas, united in a mixing chamber which narrowed towards the furnace hearth and opened by one port into the hearth.

Mr. Abram S. Hewitt became interested in the process and purchased for his firm, Messrs. Cooper,

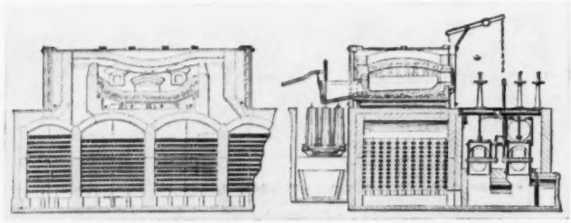


FIG. 3

Hewitt & Co. of Trenton, N. J., the patent rights for America. Their engineer, Mr. Fred J. Slade was sent over to France to study the process. On his return, erection of a four-ton furnace was started from drawings furnished by Mr. Siemens' agents in America. This furnace was started in the fall of 1868. Mr. Samuel T. Wellman, who might be called the pioneer builder of open hearths in America, was, at that time, assisting Messrs. Siemens' engineer, Mr. J. T. Potts, who had been sent to this country by C. W. Siemens to have charge of the erection and starting of the first regenerative furnace built in this country.

The second furnace to make open hearth steel in America and the first to make a commercial success of the process, was built by the Bay State Iron Works of South Boston, under the superintendence of Mr. Ralph Crooker. Mr. Crooker after watching the manufacture of open hearth steel at Trenton for some time, became convinced that with a properly constructed furnace and the use of Ferro Manganese, a good weldable steel could be made. He failed in getting Mr. Siemens' agents to supply him with plans for a furnace such as he wanted. Mr. Wellman who had left Messrs' Siemens employ several months before, was sent for, and arrangements made for plans and construction of the furnace.

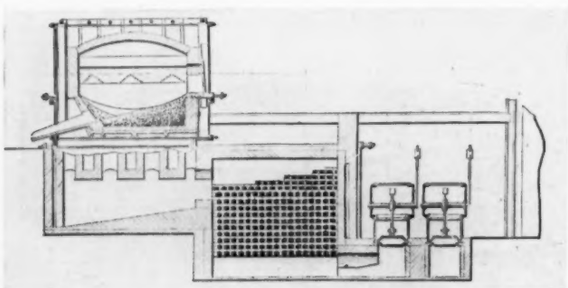


FIG. 4

This furnace, Figure 3, was put in operation in 1870. The furnace of five-ton capacity, fired with producer gas was very sharp and quick working. The air and gas regenerators were built about 1½ to 1. The ports as shown with several small ports side by side with thin division walls and extending in toward the hearth, gave a very good mixture of gas and air. These thin walls were only 4½ inches thick and burned out easily, making frequent repairs necessary. On the casting side of the furnace, in front of the tapping hole, was fastened a kind of fore-hearth, called by the workmen, from its shape, "a shoe". At the outer end of this and in the bottom was placed a firebrick nozzle, in which was fitted a fireclay stopper to regulate the flow of metal into the molds, which were carried on a turn table, operated by a steam engine through bevel gearing.

In 1872 the Nashua Iron Company placed in operation a five-ton furnace built under license of Messrs. Siemens. On this furnace, the shoe was replaced by a ladle mounted on a car, running on rails placed on the side of a deep casting pit, in which the ingot molds were placed. The car was moved by a chain and windiass worked by hand. This made it possible even though the steel was too cold to pour into molds, it was always hot enough to run clean from the furnace and not interfere with the operation of the furnace.

The first plant in the United States built for the exclusive manufacture of open hearth steel was the Otis Steel Company of Cleveland. Two seven-ton furnaces were built and placed in operation in October, 1874. These furnaces were built and designed by Mr. Wellman and were built with the charging platform ten feet above the general ground level.

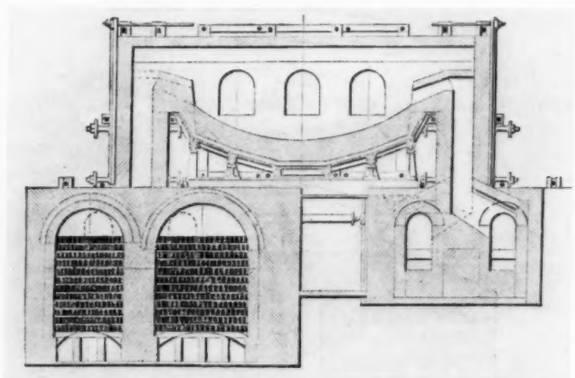


FIG. 5

The material to be melted was raised by hydraulic elevators and made the furnaces very accessible for repairs and also gave a very shallow casting pit. The steel was cast into a ladle carried on the arms of a jib crane without any lift. The one crane stood on the center line between the two furnaces and the ladle swung around to the tapping spout of each. The molds of course had to be set for the heighth of the ladle and molds of different length made a great deal of work.

In 1878 two furnaces of fifteen tons each were added to the Otis plant and were regarded at that time as of immense size. In 1881 two more fifteen-ton furnaces were added. The first basic steel produced in this country was made in these last two furnaces.

Up to this time, in the history of the open hearth there had been little change in the general layout of the furnaces. The uptakes came from the top of the regenerator chambers, which was necessary with the regenerators under the furnace. In 1887 two fifteen-ton furnaces were added to the Otis plant and were a distinct departure from anything previously built.

As shown in Figure 4 the regenerators were placed

under the charging floor and the opening into the regenerators was at the end next to the furnace. This opening in both gas and air regenerators was into a

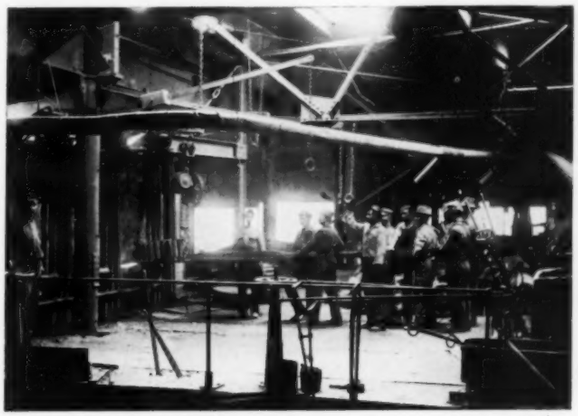


FIG. 6

large slag pocket directly under the uptakes to the ports of the furnace. This slag pocket collected the large particles carried over by the waste gas from the reactions in the hearth and also the melting brick

FIG. 7

work of the uptakes, thereby preventing stopping up of the flues in the checker brick. The ports are shown above the bath. The one in the center for gas and those on each side for air. Figure 5 shows the way the uptakes lead from the slag pockets to the ports. This general type of design after 48 years is still considered good design and only details of construction and operation have changed.

Up to the year 1895, all charging was done by hand as shown in Figure 6. A large gang of men with a long peel could handle only small pieces of scrap and it was a long hard job to charge a furnace of fifteen tons. In this year, the Wellman Seaver Morgan Company installed the first open hearth charging machine as shown in Figure 7. This was called the high type charging machine. As furnaces grew to thirty and fifty tons, overhead electric cranes with chain hoists were placed in operation for lifting steel and hot metal ladles. The lifting magnet came into general use for loading scrap into charging boxes, and the low type charging machines Figure 8 were built. These machines and ladle cranes were operated by hand controllers and the machines and motors were subjected to extensive abuse and damage by the operators desire to make "speed" by the rapid manipulation of the controller handles.

Then furnaces were built of seventy and one hundred tons. The larger heats required safe electric cranes and chargers and machines shown in Figure 9 are now in general use. They are equipped with magnetic motor controls, and while the operator may throw the master control handles as fast as he may desire, the equipment is protected from abuse by the automatic features of the magnetic control. Ladle cranes are similarly equipped and modern safety requirements call for double rope reeving, large holding automatic solenoid brakes and equalizing rachet drives on the hoists. The larger cranes having slow hook speeds, are now usually worm driven.

About 1908 the Gary Steel Works were under construction. Figure 10 shows the plans of the seventy-ton furnaces in three shops having fourteen furnaces in each shop. There are three water cooled operating doors with hydraulic lifts and two small bottom repair doors, one at each end of the furnace hearth. There is a wind box at each end of the hearth that separates the pan of the hearth from the brick work of the uptakes. These wind boxes come in very handy at times when steel or slag break out the ends of the furnace, the operator can see it and get it stopped before any great damage is done. The

FIG. 8

ports of these furnaces are very much like Figure 11. The gas port in the center with the air ports above and back of the gas port.

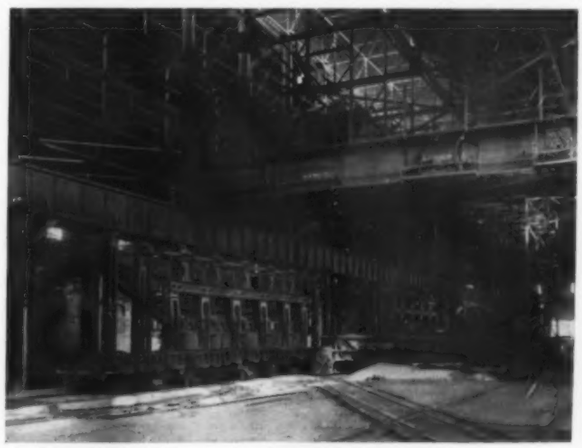


FIG. 9

In most cases the seventy-ton furnaces were made into one hundred thirteen ton and even one hundred

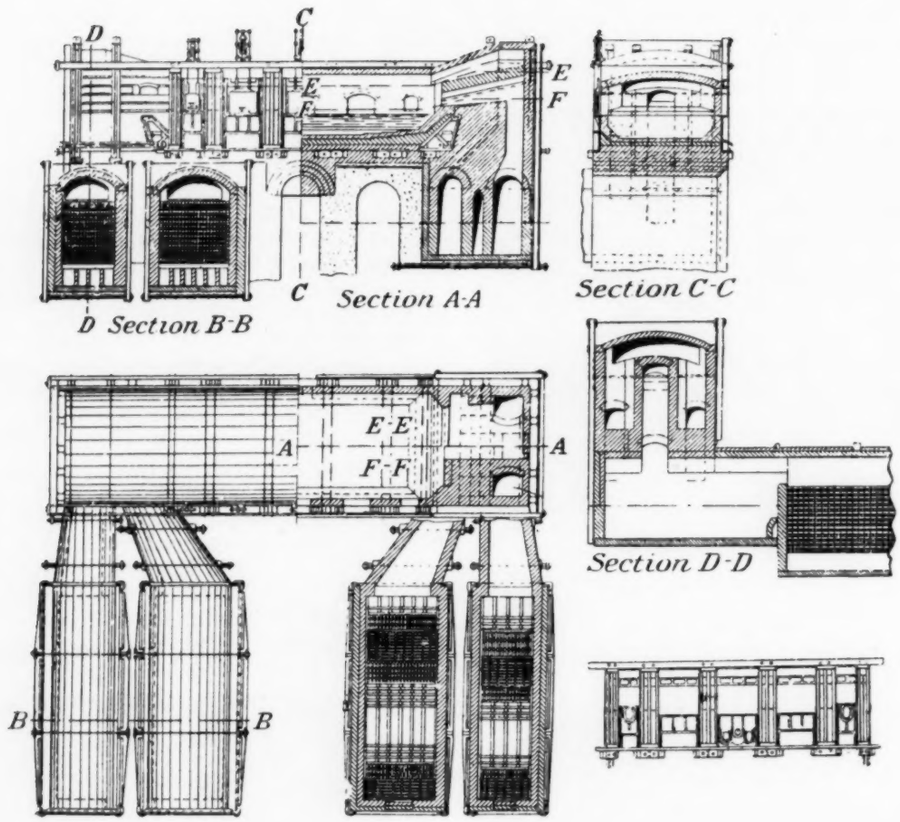


FIG. 10

forty ton furnaces by making a few changes. As a rule this consisted of moving the two buckstays at the small repair doors and replacing with a regulation operating door, making a five door furnace. The sill plate of the doors are raised three or more inches and the straight backwall replaced with a sloping backwall. When this change was made, as a rule, one motor electric driven door lift is installed. The one motor operating any one door or all at any time when the operator so desires. There are two distinct features of the electric operated door over

FIG. 11

the hydraulic operated. It does away with high pressure water lines over the roofs of the furnaces, that very often spring leaks and and allow water to get on the hot silica brick and cause failure of the roof brick. Then the electric door stays where it is set, while if a valve leaks in the hydraulic door lift, it never stays set, usually going up and the men have to work in excessive heat.

The last open hearth plant built in this country, started by tapping one hundred fifty ton heats, now tap two hundred twenty tons into one ladle. Other plants have increased the size of their furnaces, tapping as high as three hundred tons, usually into two ladles by means of a "Y" steel runner. The bottom of these furnaces and even the smaller furnaces were all made up by gangs of men with shovels until the dolomite machine was placed on the market. The dolomite is fed from a hopper through a regulating valve onto a high speed belt and thrown at any point desired on the back wall. The front wall is made up by deflecting the dolomite from a spoon held in the furnace. Two men can make up an entire furnace bottom in 15 minutes as against six or seven men by hand in 30 minutes. The latest type door frame is an all welded frame and is used without any brick arch, the protruding section fitting close to the bottom of the skew back channel.

The principle of burning iron with oxygen has been known since 1776 but it has only been within the last ten years that it has come into general use around the open hearths, saving hard labor and time. At first it was used from the oxygen cylinders and

as its use showed a saving in time on furnaces and less off heats resulted, the oxygen lance was used. The wood sleeve keeping the pipe from burning too rapidly. In the last four years central oxygen stations have been built and are supplied by tanks or car loads of liquid oxygen and then piped to the back of the open hearth furnaces for burning out tap holes when tapping heats and also piped to the pouring platform for burning out ladle nozzles frozen up with steel.

Fuels

The gas producer is still extensively used as a source of fuel for the open hearth furnaces. The original inclined grate producer of C. W. Siemens would look strange along side of the modern producer of today shown in Figure 12.

The first mechanical poked continuous gas producer was built in 1897. The gas producer shown is automatic from infeed of coal to ash disposal. The water cooled poker is carried in an oscillating water cooled bearing driven through a segmented gear. The poker is inclined at an angle from the vertical towards the approaching rotating fuel, and also is inclined at an angle radially to secure a slight lifting of the fuel. Figure 13 shows one type of ports used for producer gas.

A is the uptake for the gas and B the air uptake. C are down takes being used only for waste gas on the outgoing end of the furnace.

Since the advent of the by-product coke plant some 25 years ago, the steel plants have been making in their own plants large quantities of coke gas

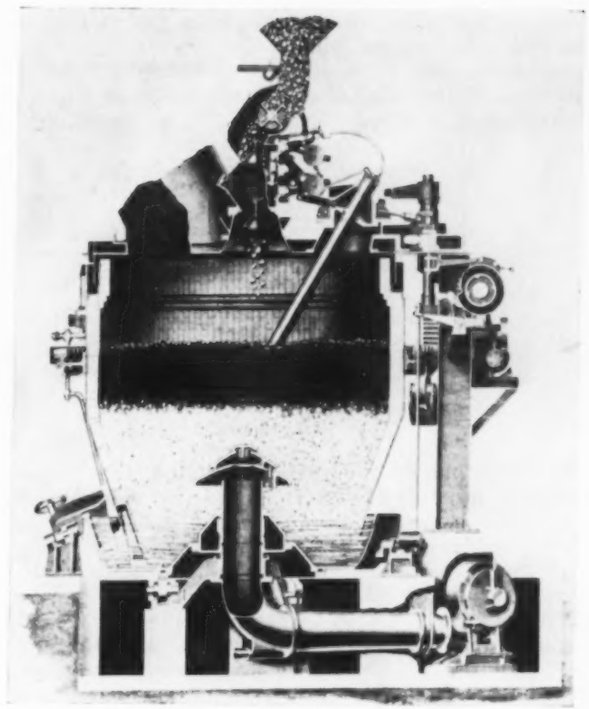
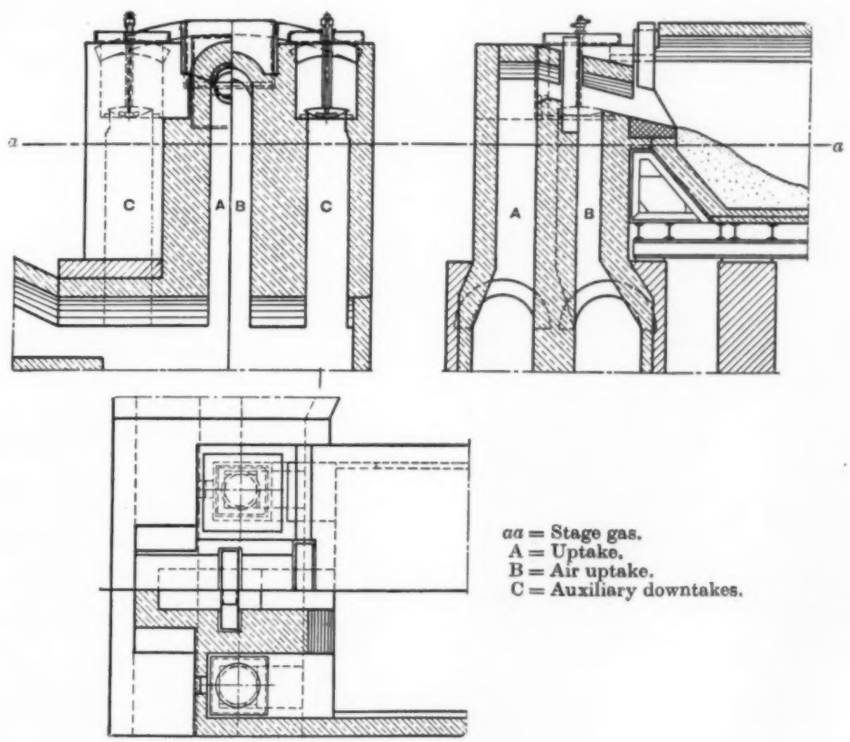


FIG. 12

and tar, and the open hearth furnaces have been the principal user of this fuel, especially over Saturday and Sunday when the mills are down. This fuel is used in the open hearth in several ways. Namely:



aa = Stage gas.
A = Uptake.
B = Air uptake.
C = Auxiliary downtakes.

FIG. 13

straight coke gas, straight tar, coke gas and tar, coke gas and blast furnace gas, coke gas and natural gas and coke gas and oil.

One of the most successful straight coke gas furnaces is the McKune furnace. Figure 14. This furnace uses a valve to reduce the port opening on

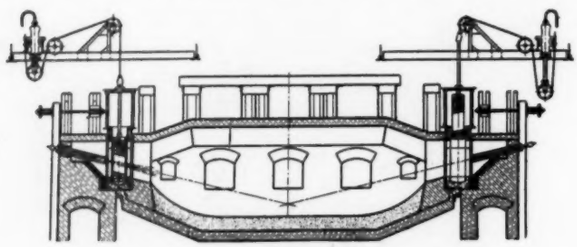


FIG. 14

the firing end of the furnace and on the outgoing end the valve is raised to permit wide open ports for the expanded waste gas. Figure 15 shows horizontal valves for a McKune furnace.

I might state that the McKune furnace with its controls is automatic. Mr. McKune states he would rather not have a first helper near the furnace while melting down for the first 6 hours of the heat.

Tar and oil may be used in most any open hearth furnace by installing a burner at the ends of the furnace. When only liquid fuel is used, the outside uptakes are made larger and the middle flue is replaced by a refractory wall under the burner with wing walls built on each side of the burner.

These burners are usually water cooled and are 6 to 8 feet in length made up of 6" pipe on the outside with a 1" or 2" pipe placed in the center and welded at each end. At the furnace end the 1" pipe is open and flush with the end of the burner. On the outside end of the 1" pipe there is a "T" and the oil or tar nozzle is placed in the "T" so that the oil goes straight with the 1" pipe and the atomizing steam or air is admitted at right angles to the tar nozzle. There is a fresh water supply pipe extending to the nose of the burner and the hot cooling water is discharged at the top. Steam for atomizing the tar or oil seems to be the prevailing practice as it is generated in the waste heat boilers which are connected in the furnace flues. With all the available heat in the open hearth, superheated steam for atomizing is fast becoming general practice. The steam is superheated in coils placed in the waste gas flues or by a bend of pipe placed in the checker chambers. By installing a length bend of pipe on top of the checkers of the regenerators, 500 degrees superheat may be obtained.

Furnaces fired with a combination of coke gas and tar or coke gas and oil are very similar to an oil fired furnace. The burner however is larger, being made up with a 12" outside pipe with a 6" inside pipe for the coke gas, while the tar is brought through a pipe over the gas, or it is brought through a pipe inside the gas pipe.

Natural gas is used extensively in certain sections of the country where it is available at very reasonable rates. This gas is usually introduced through 4" or 5" dry pipes in each side of the furnace, about 3 feet back of the hearth and slightly above it. The air coming from the ports at the end of the furnace, on a down slope toward the hearth, where it ignites with the gas sweeping it over the hearth.

The thermal efficiency of an open hearth furnace at its best is none too good. About 20% of the total available heat is utilized in the steel making operations of melting the charge, making the slag and heating it to the tapping temperature. In the past, seven million BTU's per ton of steel was considered good practice, but today we hear three million BTU's per ton is considered good practice. It is the writer's belief that this large reduction of

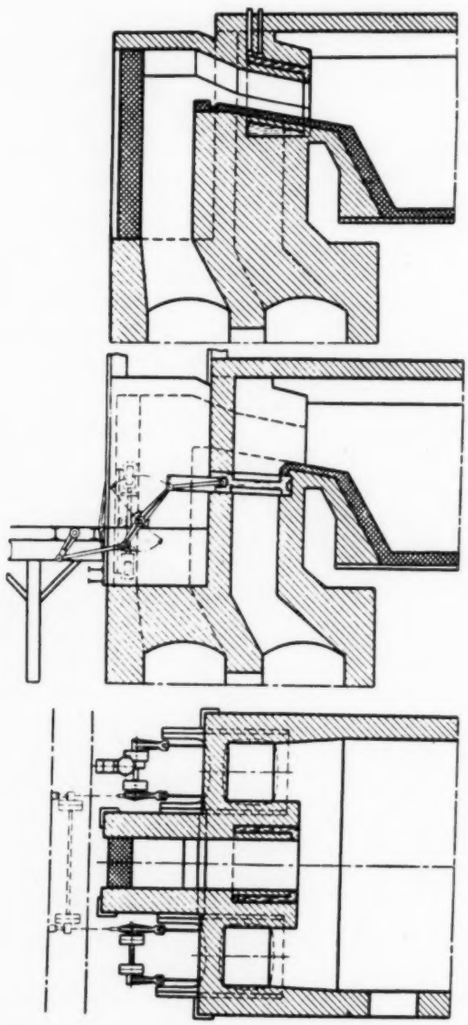


FIG. 15

BTU's per ton of steel has been made in the last five years, due in a large part to the engineers who have designed instruments that will tell the operating man what his furnace is doing.

Meters

Not so very many years ago, there was not a gas meter on the market that was dependable with constant use and we had to have repairmen on the job

most of the time. Today there are several very reliable and accurate gas flow meters on the market. Most of these are based on the principle of a differential pressure, caused by the flow of gas through an orifice. They are equipped with pressure compensators and operate over a long period of time without much attention. They are also equipped with indicating, integrating and recording instruments.

The liquid flow meters have not kept pace with the gas meters. Several years ago there was a displacement meter on the market, but a great deal of trouble was experienced, due to leaks around the packing box of the integrator and when this was stopped, it generally caused a large percentage of error, due to friction. There are, however, today several accurate liquid meters equipped with recording and integrating equipment, but these must be corrected each day for temperature.

Pressure and vacuum gauges, either indicating or recording are available in a good many makes and are very reliable and operate for long periods of time without any trouble.

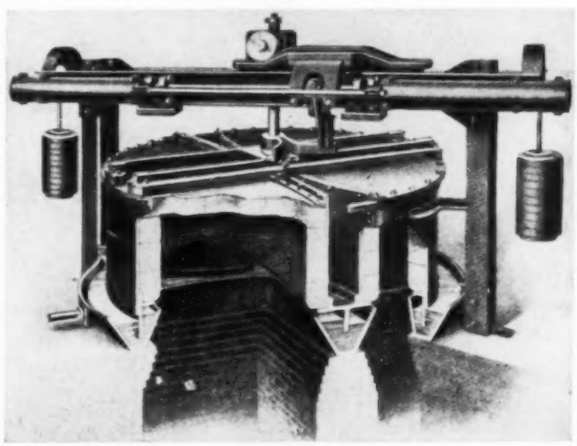


FIG. 16

Steam pressure gauges should be installed on gas producer fired furnaces and tar or oil fired furnaces should be equipped with steam pressure and liquid fuel pressure gauges.

Reversing Valves

The earliest reversing valve was the Siemens' butterfly valve. The air or gas enters the top of the valve into the regenerators, while the waste gas leaves the regenerators through the valve to the stack. Figure 16 is the American Bell or Dyble valve and is hydraulicly operated.

The ram first lifts the valve out of the water seal, then rotates to the proper position and drops the valve into the seal. One of the last of the water sealed type of valve brought out in 1900 was the Porter valve as shown in Figure 18.

The center port is connected to the stack and the outside ports to the respective regenerators. Air or gas connected to the top of the valves. The air or gas going to the regenerator that is not connected with the stack. The last two valves shown are water sealed and brick lined. The waste gas must flow through short bends, making four right angle directional changes through the valve to the stack. In order to avoid so many directional changes in the waste gas flow, there has been designed the sliding type valve.

This valve is a welded water cooled frame, set in the brick work of the flue, slightly off the vertical with a welded water cooled damper that slides on the frame. The damper is operated by a motor connected to a windlass. When the damper is closed the air valves are opened. This gives a straight flow of gas through the damper and reversal from air intake to waste gas outflow is made in fifteen seconds, while the older type valves would take a minute to a minute and one-half for reversal. The saving of time is obvious, as the time a furnace is reversing, the gas is shut off. A furnace reversing three times an hour with the older type valve, the gas would be off one hour and one-half per day, where as the slide type valve the gas would be off eighteen minutes per day.

There is a heat resisting cast steel dry type slide damper on the market that gives very good service, that replaces the water cooled damper. It is a built up section that allows for expansion. The sections are made of a heat resisting cast steel, held together by the damper lifting rod.

Insulation

The next step in reducing the heat losses in the open hearth furnaces is by insulation. About eight years ago, insulation of the regenerators was considered a possibility and several furnaces were built with boiler plate sealed regenerators. Between the

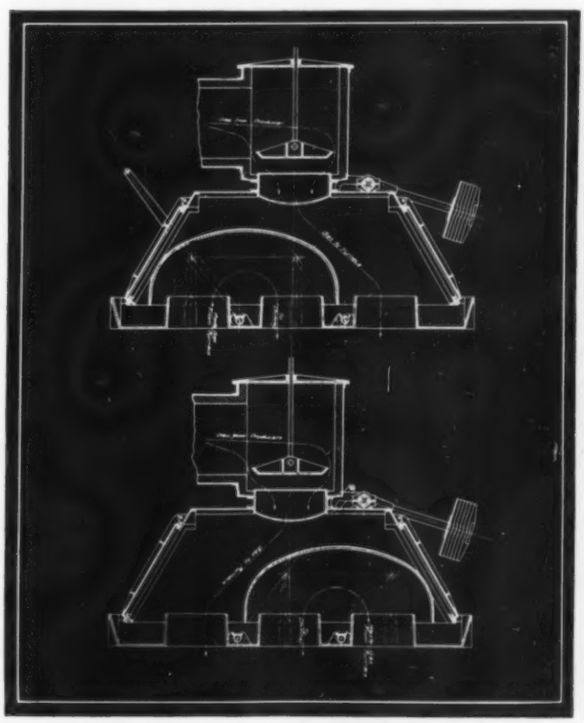


FIG. 17

boiler plate and the regular brick work, an insulating material was placed, such as asbestos blocks about 2" or 3" thick. The fan tails or flues leading to the slag pockets and the uptakes leading to the ports

were not insulated, as the temperature was considered too high for insulation.

Today, insulation from the main roof of furnace

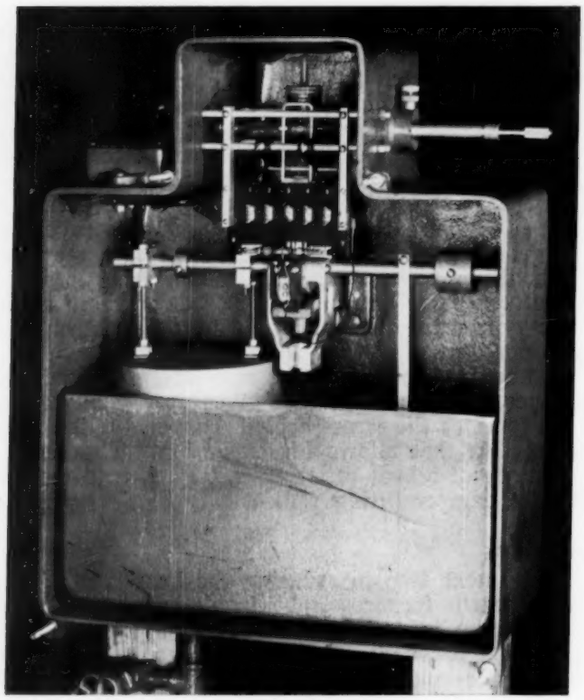


FIG. 18

to the stack is essential to good thermal efficiency and longer life of the furnace.

Where possible, a sealed boiler plate furnace lined with high grade insulating brick between the boiler plate and firebrick is considered very good practice, except for the roof and end walls. There are in this country several furnaces of small capacity that have an insulating brick on top of the silica roof brick. For old construction, insulation is done by using slag wool or expanded vermiculite mixed with plastic fireclay. This is plastered on the outside surface of the furnace walls and held by roofers nails. The first one inch is placed and allowed to set and in most cases cracks. Then a second one inch coating is placed and usually shows very little cracking. The roofs are first covered with 3 to 4 inches of granuals and then covered with slag wool or the expanded vermiculite.

Fuel saving from insulation is estimated from 3 to 10%. This wide variation depends on the practice of the individual plant. One plant may have very leaky furnaces and after insulation will show 10% fuel saving, while another plant with tight furnaces will only show a savings of 3% on fuel. A good insulated furnace should not only show a low BTU consumption per ton of steel, but should show a very fair cost on furnace repairs, as the brick work is held at a more uniform temperature which should reduce the tendency to spall.

Furnace Control

Now that we have our furnaces equipped with latest type of reversing valves, insulated and equipped with good fuel meters, we come to the problem of automatic control. There are a large number of these controls on the market and most of them would give very satisfactory results, providing the crews on the furnaces can be instructed in such a way that they will know the actual functions of the various controls.

In the writer's opinion, the furnace pressure control is of first importance. A slight pressure in the furnace will hold the products of combustion over the hearth just long enough to give off its heat to the bath and still maintain its flow through the furnace. This furnace pressure is constantly changing, due to reactions in the bath, the lifting of a door and the regulating of the fuel, and even the most expert furnace man could not keep up with these changes.

The control proper consists of but three principal devices. A pressure controller, a relay and an operated damper drive. Through a pipe installed in one

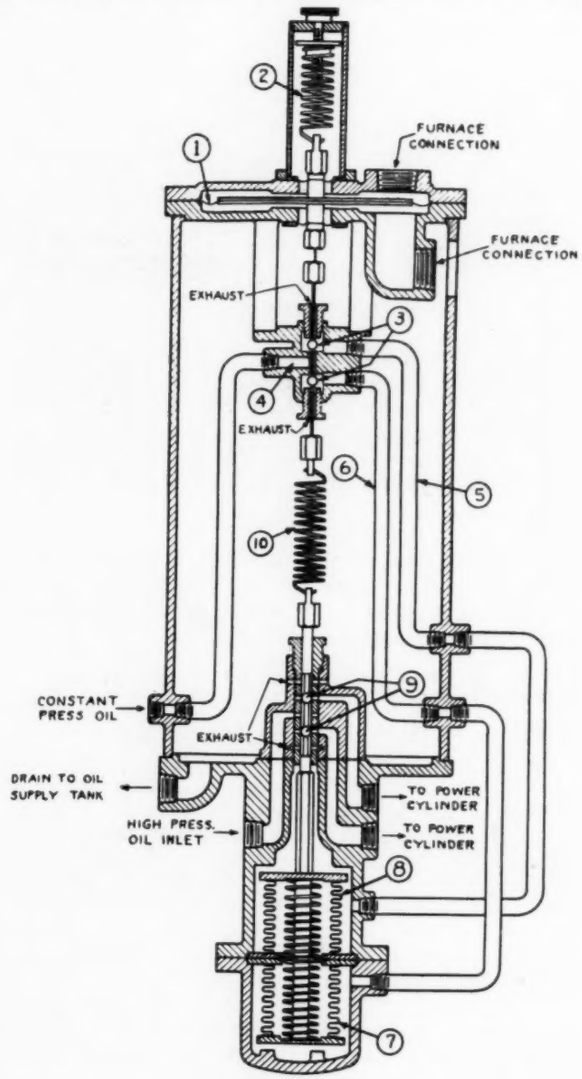


FIG. 19

or several parts of the furnace, the pressure is transmitted to a bell or a diaphragm in the controller. This slight movement up or down sets up a slight

pressure or change in the relay, which is transmitted to the prime mover of the damper.

Figure 18 is an electrically operated pressure control. The pipe as shown is connected to the furnace, the bell is moved up or down by changes of pressure in the furnace, as the bell goes up or down it tilts a balanced beam that carries electrical contacts and as it tilts either way, the contact closes and energizes the electric relay. The relay instantly energizes the motor drive which adjusts the damper to increase or decrease the effective opening in the stack.

Figure 19 shows a pressure control operated by oil. Here the pressure of the furnace acts on a diaphragm (1) and the force exerted by the action of this pressure on the diaphragm area is counter balanced by a loading spring (2). Adjustment of the tension in the loading spring (2) provides the means of establishing the pressure to be regulated.

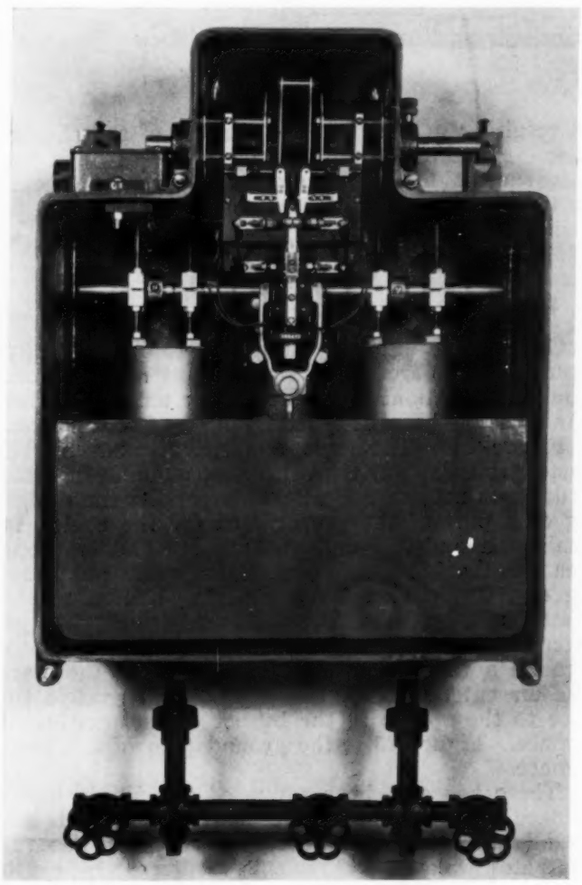


FIG. 20

Movements of diaphragm are transmitted through a flexible mechanical connection to an impulse pilot valve (3) which controls a double impulse actuating the pilot valve (9) by means of the metallic bellows (7) and (8). The free ends of bellows (7 and 8) are rigidly connected to each other and also to pilot valve (9). An increase in the pressure of the oil surrounding bellows (7) will cause a contraction of this bellows, which will raise pilot valve (9) so as to uncover the upper port to oil supply and uncover the lower port to oil exhaust, thereby controlling the flow of oil to and from the power cylinder, operating the damper or valve. A movement of pilot valve (9) in either direction, reacts through the stabilizing spring (10) on the impulse valve (3) and diaphragm (1) in the correct sense to retard the initial movement of diaphragm (1) to prevent over travel of the power cylinder.

FIG. 21

After the open hearth furnace has been equipped with pressure control in order that the bath will receive the maximum heat of combustion, the temperature of the checkers should be automatically controlled. This is accomplished by placing thermocouples in the two regenerator systems of the furnace. The thermocouples are connected to a micromax temperature difference controller. When the temperature of one of the two couples differs from the other by a set number of degrees the controller automatically reverses the furnace. This control keeps both ends of the furnace working at the same temperature and prevents the checkers from becoming so hot that they burn, clogging the checker work and sending heat out of the regenerators into the stack.

Fuel air ratio controls are operated by double acting pressure controls already described, from both sides of orifices placed in fuel and air lines. Short pipes transmit pressure variations to the controllers, which in turn operate the valves in the air and fuel line to give a certain fixed air ratio to the fuel being used. This ratio may be adjusted for various conditions in the furnace. Figure 20 is an electrically operated fuel air ratio control.

One of the most distinctive furnace designs made in recent years is the Isley furnace control. Figure 21 is a conventional view of an open hearth furnace with its regenerator chambers folded out and each end of the furnace system equipped with an Isley control unit. At the throat of each of the venturi type stack, there is a small damper. The nozzle is connected with a low pressure fan mounted on the outside on its own foundation and driven by a motor. The operation is as follows: On the incoming side the damper is closed, deflecting the air from the fan into the checker chambers, while at the other end of the system the damper is open and the air from the fan ejects the waste gases. The draft being regulated by the speed of the motor, increasing or decreasing the flow of air through the nozzle.

With the furnace pressure control and fuel air control, we should have the analysis of the waste gas, in order that the operator may know if his fuel to air ratio is correct. The reactions of the bath must be considered, as at times, large quantities of

carbon monoxide is formed and air must be supplied to take care of its combustion. There has been a continuous waste gas analyzer used in industrial

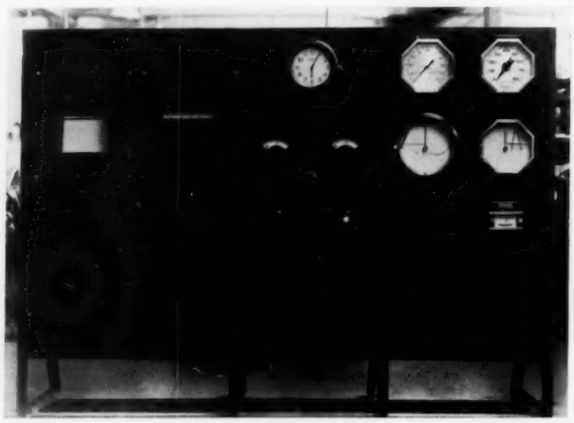


FIG. 22

furnaces for some time and is now being used in open hearth furnace control. With a set percentage of excess oxygen in the waste gas, the air is automatically controlled. The greatest difficulty experienced with this control, which will soon be overcome, is the taking of the continuous sample of waste gas at the high temperature of the open hearth furnace.

The latest development is the roof temperature control. A pyrometer is focused on a renewable roof brick of given thickness and the temperature is indicated at the furnace control panel. It is the writer's understanding that there is an experimental installation, whereby the roof temperature control regulates the fuel input, but I have not heard any reports on this control. Figure 22 shows a complete operating panel of the modern open hearth furnace.

For many years there have been various types of checker brick patented and there has been only an estimation on the results obtained. Many furnaces

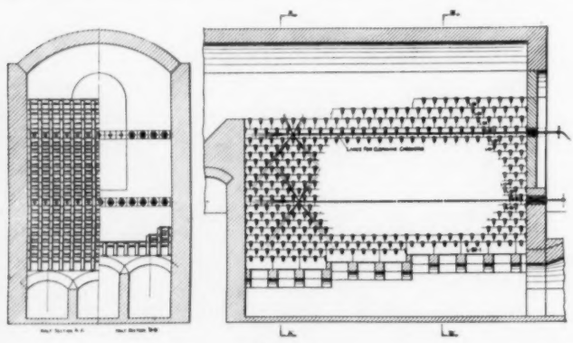


FIG. 23

of today use the straight 4x4 checker brick, but, with controlled pressure, controlled combustion, regenerator temperature and insulated furnaces, it will be possible to go into the study of checker brick. One of the more recent designs of checkers is shown in Figure 23. These checkers may be blown very thoroughly by means of a checker blower, inserted through special shaped brick in the bulk head of the regenerator chamber.

There has been several installations of multiple pass checker chambers. These passes have been placed vertically and horizontally. The vertical multiple pass chambers failed, due to the excess temperature in the pass next to the slag pockets. This pass receiving the hottest waste gas and the hottest

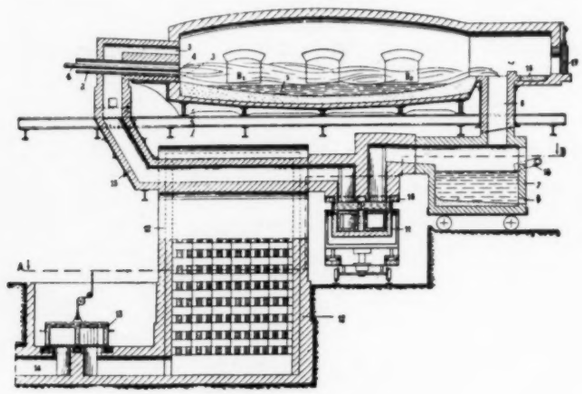


FIG. 24

air, resulting in the complete melting of the checker brick. Horizontal multiple pass checkers have had some success by decreasing the checker volume in the top pass connected to the slag pockets and using a silica checker brick.

The Future

On looking into the future of the open hearth furnaces, there are two designs not tried out, which should be mentioned. A furnace system on entirely new lines has been designed by F. W. Corsalli shown in Figure 24. The fuel is admitted at one end. The waste gas escape at the other end and the direction of flame is never changed. This permits the designing of a port of the proper area for the cooler, incoming air and fuel and an outgoing end of proper area for the hot waste gas. The waste gas entering one slag pocket keeps the slag molten so that it may be tapped off. From this slag pocket the gas enters a reversing valve through the regenerator, through a further reversing valve and to the stack. The air entering as in the regular regenerative furnace to the uptake at the burner or fuel end of the furnace. Figure 25 is the ground plan of a Corsalli furnace.

There has also been proposed a multiple burner furnace illustrated in Figure 26. The furnace is continually fired at the four corners. The waste gases are alternately taken off at the ends to alternately heat the regenerators. The diagram shows waste gas being taken off its right end. It looks very much as if the brick manufacturers will have to make a super refractory brick to take care of the temperatures on the roof that might result in a furnace of this type.

Plans for charging a regenerative furnace in one minute are being made as of this date. The furnace is being designed with a removable front wall. The entire front wall being hoisted vertically. The charging machine being a 40-foot car with a tilting bottom. The entire charge, limestone and scrap of long lengths is fed on to the hearth by moving chains,

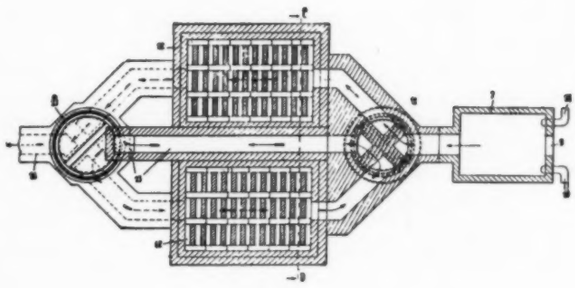


FIG. 25

sliding it off the tilted bottom of the car. This type of furnace may use a suspended roof designed for an open hearth furnace.

At the present time we are not allowed to increase our tonnage capacity by new construction, so it will be some time before we will see the furnaces just mentioned, under actual operation. In the meantime the average tons tapped per heat will probably be between 130 and 150 tons. This size of open hearth furnaces will remain the same for some time.

The author wishes to express his grateful appreciation to the Wellman Engineering Company, Publishers of the "Open Hearth" and to Ernest Benn Limited, Publishers of Hubert Hermann's book on Planning, Erection and Operation of Modern Open Hearth Steel Works, for the permission to use some illustrative material contained in these books.

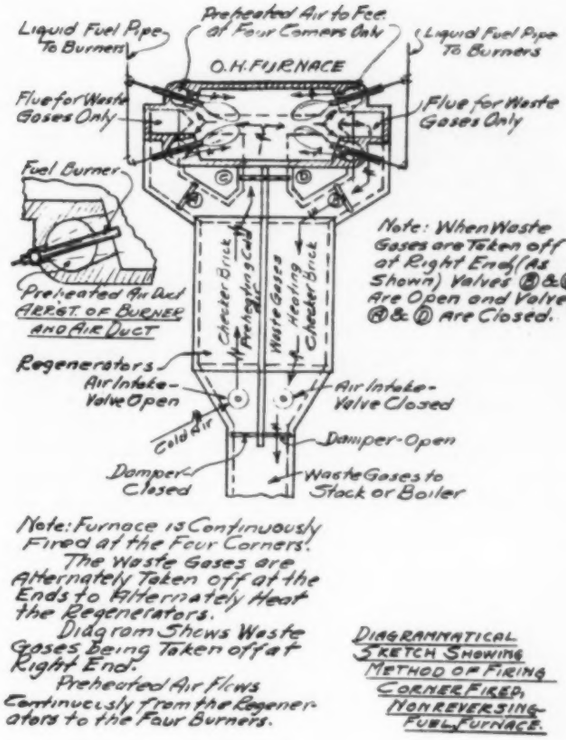

Liquid Fuel Pipe To Burners
Preheated Air to Fce. at Four Corners Only
Liquid Fuel Pipe To Burners
O.H. FURNACE
Flue for Waste Gases Only
Flue for Waste Gases Only
Fuel Burner
Note: When Waste Gases are Taken off at Right End (As Shown) Valves B & C Are Open and Valves A & D Are Closed.
Preheated Air Duct ABOVE OF BURNER AND AIR DUCT
Checker Brick Refractory Cell
Waste Gases Heating Checker Brick
Regenerators
Air Intake-Valve Open
Air Intake-Valve Closed
Cold Air
Damper-Open
Damper-Closed
Waste Gases to Stack or Boiler
Note: Furnace is Continuously Fired at the Four Corners. The Waste Gases are Alternately Taken off at the Ends to Alternately Heat the Regenerators.
Diagram Shows Waste Gases Being Taken off at Right End.
Preheated Air Flows Continuously from the Regenerators to the Four Burners.
DIAGRAMMATICAL SKETCH SHOWING METHOD OF FIRING CORNER FIRED, NONREVERSING FUEL FURNACE.

FIG. 26

DISCUSSION

Discussion presented by

T. J. McLoughlin, Fuel Engineer, Carnegie Steel Company, Duquesne, Pa.

F. E. Leahy, Fuel Engineer, Youngstown Sheet and Tube Company, Youngstown, Ohio.

R. S. Bower, Open Hearth Superintendent, Corrigan-McKinney Steel Company, Cleveland, Ohio.

A. J. Boynton, Vice President, H. A. Brassert & Company, Chicago, Ill.

E. A. Hawk, Fuel Engineer, Tennessee Coal, Iron and Railroad Company, Birmingham, Ala.

M. J. Conway, Fuel Engineer, Lukens Steel Company, Coatesville, Pa.

W. C. Buell, Jr., Engineer, Cleveland, Ohio.

F. C. Swartz, Open Hearth Superintendent, Carnegie Steel Company, Youngstown, Ohio.

T. J. McLoughlin: I don't think there is very much that I can add to this very interesting and comprehensive resumé of Mr. Bower's.

I think the open hearth men are to be complimented on the progress they have made, particularly within the last five years. Recently I had occasion to go over the records of quite a few plants. Those records show that there has been a reduction of from ten to forty per cent in the cost of melting in the last five years, and an increase in production per operating hour in some cases of as much as fifteen per cent.

From our experience I feel that one of the most interesting developments in open hearth work has been the intelligent application of forced draft to an open hearth furnace.

Another interesting thing is the development of instruments which will enable the first helper to know at all times what is going on. I have often said in our discussions that you cannot expect a man to cut a diamond with a cold chisel and a hammer. You can't expect the first helper on an open hearth to get the best results unless you give him the tools to enable him to accurately know what is going on in the furnace.

The recent developments in the way of draft control and air proportioning have contributed materially to the reduced costs.

I think particularly we should compliment the open hearth men and their engineers because, while beset with numerous metallurgical problems, when the demands of the customer for quality of product have been increasing from day to day, they have still found time to improve not only their furnace construction but their melting cost, and generally the cost of the ingot as turned over to the rolling mill.

F. E. Leahy: I would like to ask Mr. Bower what he considers the outstanding development in checker chamber design, particularly where it is used in producer gas, so that the checkers remain open for a longer period than is the average practice.

R. S. Bower: I haven't had any experience with producer gas for the past fifteen years, so I couldn't tell about that. Someone who is using producer gas can tell you more than I could.

A. J. Boynton: I want to compliment Mr. Bower on his paper. It was certainly very interesting and comprehensive. He has gone into a surprising amount of detail in a comparatively short period of time.

I have little to say in regard to the paper, excepting that part of it which deals with the subject of automatic control, in which I am personally interested.

Mr. Bower has given an exposition, in so far as time and space would permit, of the various systems of automatic regulation. I believe that the industry in general is becoming more and more thoroughly committed to the use of these systems used in connection with indicating and recording instruments. Managers and engineers recognize that there is something lacking in the attempt to operate such a valuable piece of equipment as an open hearth furnace and what goes with it and to produce such a valuable product as the resultant tonnage of steel without giving the operating people every opportunity possible to stabilize the conditions which their experience determines to be correct.

I think that the development of this feature of operating practice, in common with all other matters, has been held up by the recent depression. I think we will hope, and the indications are that we may have in the very near future, a considerable development in these particular matters of instrumentation and regulation as well as in other matters discussed, all of which will lead to a very pronounced improvement in the cost of manufacturing as well as improvement in the quality of the product.

F. E. Leahy: I understand that one of the plants in Cleveland—it may be Mr. Bower's plant—is experimenting with the operation of an automatic control using the waste gases from the furnace as the guiding medium. I was wondering if they had got anywhere with that, and whether he is ready to discuss the results they can get from such equipment as compared to the average operation of other furnaces in the plant.

R. S. Bower: We have been experimenting with that. I will say, as far as the analyzing is concerned, we haven't had any trouble with it at all. We have experienced a little difficulty in getting the samples from the sampling tube to the instrument. Those difficulties have not as yet been overcome to give us any claims on the control.

E. A. Hawk: Is there any particular advantage in having a continuous analyzer in preference to one or two samples for each reversal?

R. S. Bower: In the time we have been operating it there is a change very nearly every minute. You would be surprised what changes do take place. A slight increase in gas pressure and a slight decrease in oil pressure will change the instrument. It will change the analysis of the waste gas.

M. J. Conway: Mr. Bower has given us a splendid chronological history of the open hearth. He mentioned a consumption of 3,000,000 B.t.u. per ton. Will Mr. Bower please state if this was top poured or bottom poured practice, the percentage of hot metal and type of fuel used together with the name of the plant where this practice prevails and whether the figures are based on per net ton charged or per gross ton of ingots.

R. S. Bower: I have been told there are some furnaces making steel at this B.t.u. but have never been able to check it, however the B.t.u's have been reduced to a point where they are getting pretty close to 3,000,000 B.t.u. per ton of steel. I have heard that several plants have gone to 3,500,000 B.t.u. per ton of steel. I do think in the future we will be able to get it down to that figure.

W. C. Buell, Jr.: I enjoyed hearing Mr. Bower's paper very much and he has presented a good general picture of a lengthy and difficult subject.

There is an incident in early American open hearth history which I think is indicative of the true spirit of pioneers in settlement or industry and which warrants frequent repetition and thoughtful reception.

The Cooper-Hewitt furnace which Mr. Bower has referred to, built in Trenton, N. J., in 1868, although operated intermittently for a couple of years was a total failure, never producing satisfactory steel. During this period it was inspected several times by Ralph Crooker, then superintendent of the Bay State Iron Works of Boston, who, in spite of his failure to see steel produced from an open hearth, became so imbued that the process idea was fundamentally sound, he prevailed upon his principals to put up the money that was spent in the design and construction of the first furnace to produce open hearth steel in the United States.

Today, were more of us willing to support our best judgment with aggressive promotion, we would likely progress more rapidly.

F. C. Swartz: Mr. Bower in his paper said that the refractory companies would have to produce super refractory brick to stand the higher temperatures that are being produced in the present-day open hearth furnace. Have any of the refractory representatives a word to say on this subject and do they anticipate being able to produce a super refractory brick that will stand these temperatures?

There is one phase of Mr. Bower's paper in which he said "the day is coming when we will charge an open hearth furnace in a minute." I am afraid that day is quite distant, but I do feel that an open hearth furnace can be charged in a lot less time than it is now being charged. I believe you will agree that as furnace capacities have increased to 100 and 150 ton, charging facilities have not kept pace with the size of the furnace, and that the average size charging box for 100 to 150 ton furnaces is less than 25 cubic feet capacity. I cannot see any reason why a charging box cannot be made at least twice as large and still be handled in an open hearth furnace. The charging time, of course, would be cut in half, and the economies which would come from faster charging would be realized.

There is one plant in this district that is experimenting with charging boxes of 53 cubic foot capacity each. This experiment has been running for nearly a year and the plan seems entirely feasible and practical. This improvement is far from charging a furnace in one minute, but we should be able to charge a 100 ton furnace, with that size charging box, in at least fifteen minutes. I think we have been a little backward in developing the charging facilities for open hearth furnaces when building very large furnaces.

AUTOMATIC SCREWDOWN CONTROL

By R. M. BAYLE
Westinghouse Electric & Manufacturing Co.
Chicago, Ill.

Paper presented before the Chicago District Section of the A. I. & S. E. E., March, 1935.

The application of automatically controlled machines to steel mill processes has been a rather slow development. There have been numerous good reasons for this reluctance to adopt automatic control. Among these could be enumerated cheapness of labor, necessity for operating reliability; need for simplicity; the process and production were such that the savings could not justify the first cost. Considering these factors by present day standards we can see they are all changing, labor costs have increased, control designs are now rugged and reliable.

The technical training of the operating man has risen to the point where he can handle more complicated circuits. Modern demands call for products with very precise characteristics and in such quantities that automatic sequences can and do show remarkable savings.

In presenting the part of the Westinghouse Electric and Manufacturing Company in this discussion of automatic screwdown control I would first like to tabulate the essentials of a successful application. The most important characteristics, in my opinion, are:

1—Accuracy of setting.
2—Speed of setting.
3—Reliability.
4—Simplicity.
5—Flexibility.
6—Ruggedness.

The order of importance depends on the mill to which the automatic screwdown is applied.

It is amusing to look back over the brief history of the automatic screwdown controller and find that we tackled the toughest job first and the easiest job last.

This, so-called, tough job originated back in 1927. Previous to this time there had been an insistent demand for an I beam section with heavier flanges for column work. As skyscrapers and other structures grew larger it was necessary to fabricate the supporting columns out of smaller sections. This was very expensive. For this demand the Carnegie Steel Company developed a mill to roll an H section. This mill was installed in their Homestead works. To give you an idea of the screwdown problem I have sketched the rolling procedure on an H beam.

First we have the ingot. The shape shown at (a) Fig 1 is used for the smaller beams and the one at (b) for the larger. The blooming mill turns it out in the blank shape shown at (c). Then the roughing mill works it down to the shape shown at (d). You will notice we have two rolls in tandem in this mill. First we enter the edger, shown at (g) whose rolling surfaces are tapered. They are working the surface down at (h) only. The flat of the roll may or may not touch the web. These rolls are driven by a 2000 H.P. motor.

Then it enters the main rolls, shown at (i) which work down the web at the point (j) and also the thickness of the flange at point (k) squeezing it against the idling flange rolls shown as (1). This drive requires a 7000 H.P. motor. Thus you will see we have three screwdown adjustments:

a. Edger rolls up and down (flange width).
b. Main rolls up and down (web thickness).
c. Flange rolls in and out (flange thickness).

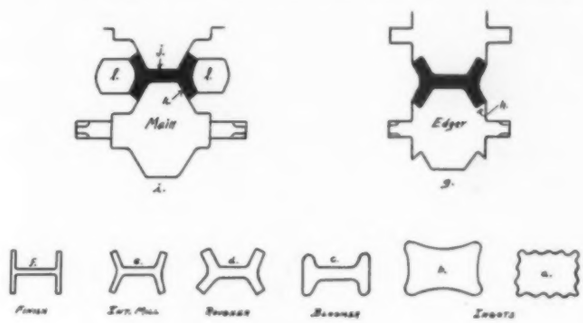


FIG. 1.

The intermediate mill further reduces the sections in the same manner and gives it the form shown at "e". In fact it finishes it with the exception of straightening up the flange. The finishing stand straightens up the flange with a single pair of vertical rolls giving the finished shape "f".

Briefly this shows how impossible it would have been to make a successful mill without some automatic means of setting the screws. We must make three settings simultaneously in the minimum of time. That time is the time the end of the piece leaves the mill and is reversed on the table and reentered. We must also regulate the relative speeds between the edger and the main motor so as not to buckle light sections or overload either motor on heavy sections. This is different for each pass. Furthermore, we must accurately set each of the three screws. We can't set somewhere near it as in blooming mill practice. Here we are working a compound shape; in fact you might consider the combination of the three sets of rolls as a huge extruding die.

As I mentioned before the first installation made in 1927 was at the Homestead Works of the Carnegie Steel Co. Six units were supplied for this mill. We then supplied one unit for a plate mill at the Gulf States Steel Co. in Gadsden, Alabama, and then six more units for another beam mill, located in our own midst, at the South Works of the Illinois Steel Co. This latter installation is the most modern and contains many improvements.

Now with the aid of some illustrations I will comment on the various design details of the units as we go along. Unfortunately I could find only three illustrations showing this type of automatic screwdown.

Figure 2 shows the limit switch; the heart and soul of the automatic screwdown control. This is one of the first switches furnished for the Homestead installation. It was connected directly to the mill by a magnetic clutch and a shaft. This view is from a control balcony at the height of the top

of the housings. This limit switch controls a rheostatic type of reversing plugging control.

Figure 3 shows the limit switch supplied for Gulf States Steel Co. This unit and the six for South Works are connected to the mill by synchronous

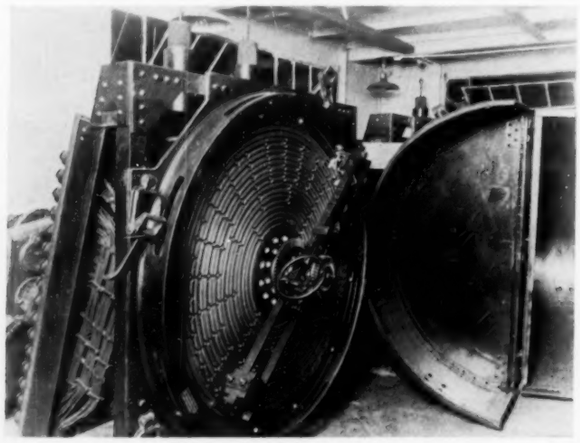


FIG. 2.

ties of 3 H.P. capacity. The location can be made much more accessible in this way.

The units at South Works are located in the motor room and the schedule changes in setups are made by the chief operator and his helper.

For a brief explanation of the operation I shall confine myself to this latest application of this type. As I explained before one of these limit switches is applied to each of the three screwdowns for any individual mill.

The rotating arm is common to one side of the control circuit. The points of stopping are controlled by a series of four segments and a button. The whole development is a spiral of about 150 of these groups. As the screwdown motor rotates the arm turns and a bevel gear moves the contact block in and out to conform to this spiral. Full travel is about twenty turns.

The stopping points are selected by a plug board on the rear of the limit switch. Every point, not in use, is shorted out by a three point plug. The pick-up plug for an individual pass contains five points. For the roughing mill 17 passes are available but the average beam requires but 9 passes. For the intermediate finishing mill 11 passes are available but only five are used on the average rolling schedule.

The screwdown motors are all rated at 75 H.P. one hour and are of the totally enclosed mill type. Each screwdown motor is controlled by variable voltage from an individual 120 kw. generator. These later types were designed for variable voltage in the interests of greater speed and quicker and more precise stopping. Each motor has a control panel about 36" wide and 80" high containing the line contactor, field contactors, voltage regulators, protective devices and various sequence relays.

There is also a pass selector panel consisting of a group of six pole double throw contactors which select the passes simultaneously for the three screwdowns used on the one mill.

In the pulpit the operator has a pass selector switch, a hand operating master switch for each of the three screwdowns and a hand automatic selector switch.

Figure 4 is a view of the edger speed selector panel also tied in with the automatic screwdown control. It is mounted in the operator's pulpit. With the auto selector switch in the back position the hand rheostat is in operation. Speeds can be selected for each pass. In the other direction the pass master will select whatever speed is plugged in for that pass. This rheostat is rarely used after the initial setup of a shape. The operators judge their speeds by the load division between the edger and main motor.

I would like to give you a brief idea of the way this screwdown control operates. As I said before each screwdown has about a hundred and fifty points available for stops. In the roughing mill the total travel is about eight inches and the points are .040" apart at the lower end and .080" apart at the upper end.

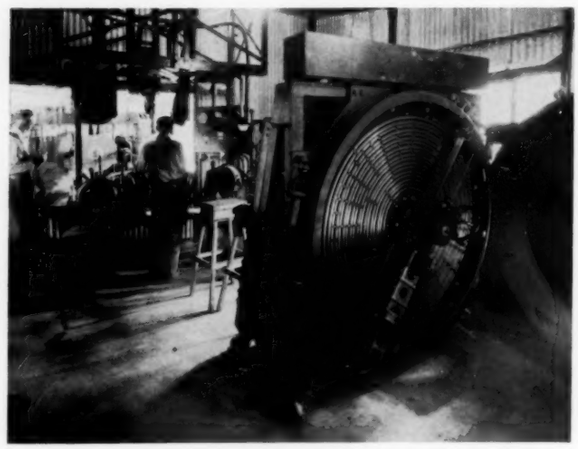


FIG. 3.

At the intermediate finishing mill the total range is from 2 to 2.6 inches and the steps from .010" to .040".

The four segments and button for each stop are utilized as follows. These two (a and b, Fig. 5), control the generator directional field contactors. These two (c and d, Fig. 5) are used for the slowdown. The button is used for restarting. No matter where the arm is when this point is opened up the directionals are set up to bring the arm to it.

The initial field application puts about 350 volts on the 230 volt motor. A voltage regulator limits this voltage to 400 volts maximum. Rapid acceleration and travel are thus secured.

During normal rollings these loads run the motor, at about 300% of its continuous enclosed rating, requiring force ventilation.

The slowdown circuit is a continuous resistor circuit with a voltage regulator calibrating coil in series with the tap off at the stopping point. Now if the arm starts out here somewhere ("e", Fig. 5) little control of the field takes place. Three hundred and fifty volts will be maintained, the limiting regulator only being predominate. As the arm comes towards

the stopping point resistance is cut out and the slowdown regulator gradually reduces the voltage. At the stop the current reaches a maximum and a relay cuts in the slowdown field value. This is about 200 volts, by no means a creeping value. We have to work fast. The usual stop overshoots a slight

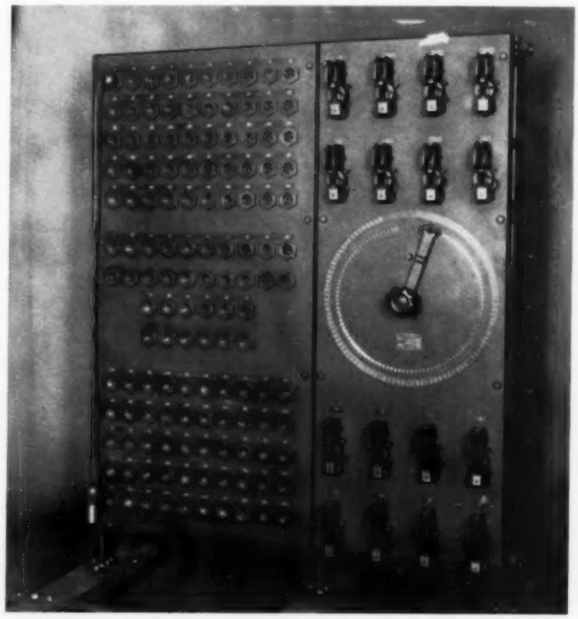


FIG. 4

amount and then plugs back and stops. A second plug back is locked out by a relay sequence. The accuracy requirements do not need a repeated hunting to stop on the point. The overswing is not what you would imagine. The arm swoops down, slows up, overswings a slight amount backs up and that is all.

Under average rolling it takes about one minute to make nine passes on the roughing mill. The three screwdown selections are made for each pass in approximately four seconds total.

At the intermediate finishing mill the five passes of an average section are made in about 1.25 minutes. The section is now longer and it takes more time in the mill. The three screw settings, however, take only about two or three seconds.

Compare these times with those of three manual operators and you can see where this automatic control pays for itself in tonnage.

The second type of automatic screwdown control commercially applied by our company is a very simple type for three high sheet mills. When this type of mill is made wide enough to handle sheets for automobile body work the screws cannot be manipulated easily by hand. A simple motor drive is sufficient. Precision of settings is not so important. What the roller needs is flexibility. If the accuracy does not vary rapidly from hour to hour no hindrance to production is experienced. The rollers on such mills gauge by length rather than thickness. The screwdown motors are small and are connected to the mill by a large reduction. Simple limit switch operation with no slowdown is used. After the limit switch opens double dynamic braking and a magnetic brake stops the motor. This method of stopping has been found to be more than sufficiently accurate.

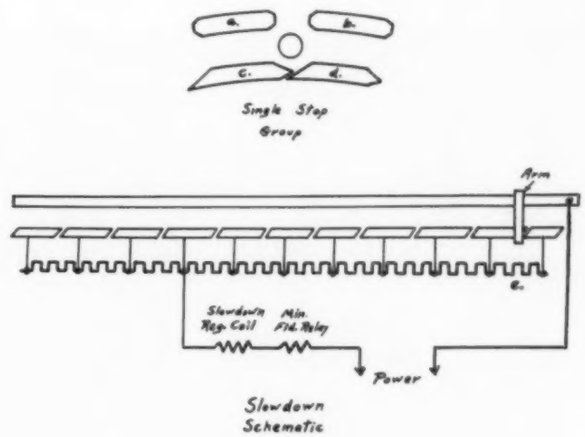


FIG. 5

Two units of this type are in operation at the plant of The Great Lakes Steel Co., Ecorse, Mich., and one at the Campbell Works of the Youngstown Sheet and Tube Co., Youngstown, Ohio.

Figure 6 shows the type of mill to which this automatic control is applied. It is equipped with catcher tables. The automatic screwdown control is arranged for seven passes. All passes are progressively downwards with the exception of the third and fifth which can be arranged to open the rolls for matched pack rolling.

Figure 7 shows the type of limit switch used. It sets out on the floor handy to the roller and serves as a master control station. Each slot represents a pass and an easily adjustable dog travels in that slot. The slots are graduated in thousandths not as a measure of total roll opening, although that

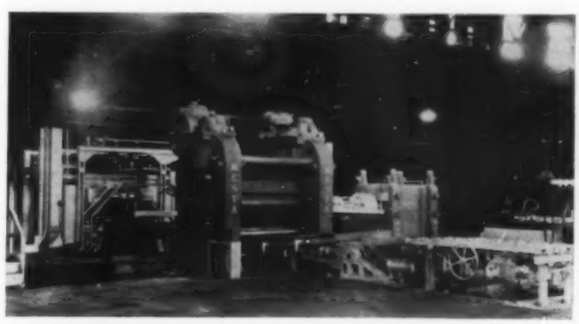


FIG. 6

is approximately true, but more for a relative measure. In this particular design Pass 2 must be further along than Pass 1. Pass 3 may be set on either side but a selector switch must be thrown for the proper direction from Pass 2. Pass 4 must be progressive but Pass 5 may be up or down. Passes 6 and 7 are progressively downwards in gauge.

Pilot lights show the pass in use. The top right button is the master pass button. Pressing it shifts to the next limit switch setting. The button to the top left is the "last pass" button used to reset for

the next pair of sheets. The middle two button station is used to apply or cut off the power to the screwdown control. The remaining two buttons are used to control the furnaces which supply sheets to the mill. The small master switch on the right is

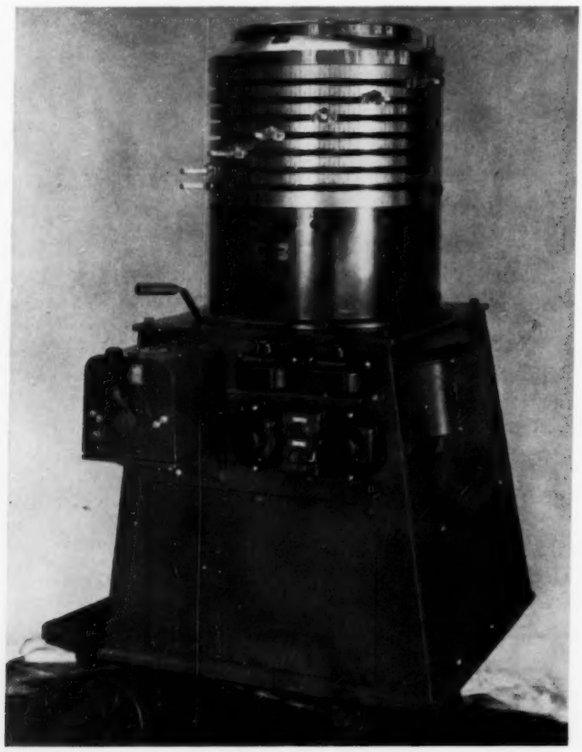


FIG. 7

the hand control master switch. It is always available for use. If it is used the automatic is disconnected and must be reset to Pass 1 by the last pass button. You can then proceed to the required pass by successive pushes on the master pass button. The lever shown just below the cylindrical portion shifts the entire outside of the limit switch and is used to make corrections, in the sheet length. If the length is off the operator merely bumps it a little one way or the other and thus changes not only the last pass but all other passes in proportion.

Figure 8 shows a view of the inside of this same master switch. The whole internal assembly is connected to the screwdown motor by a synchronous tie unit through suitable gearing. The limit switch revolves approximately 190 degrees for .360" opening of the mill. A gear shift is supplied by which this ratio can be doubled so that 190° equals .720" on the mill. The former is used for finishing and the latter for roughing.

When the power on button is pressed the synchronous ties are first energized and when they are tied together the interlocking closes in the D.C. control circuit.

Each pass stop is controlled by a cam type limit switch which opens when it strikes the dog for that pass. You will remember from the previous view the stopping dogs which travel in the slots, one for each pass. Each limit switch is bypassed by a condenser to eliminate arcing.

The slip rings carry the individual circuits to the limit switches.

Figure 9 shows the control panel mounted in a dust tight case. The seven relays on the upper left hand panel control the pass limit switches. Every time the master pass button is pressed one relay goes in and the preceding one drops out. Just below are the pilot sequence relays for the pass relays.

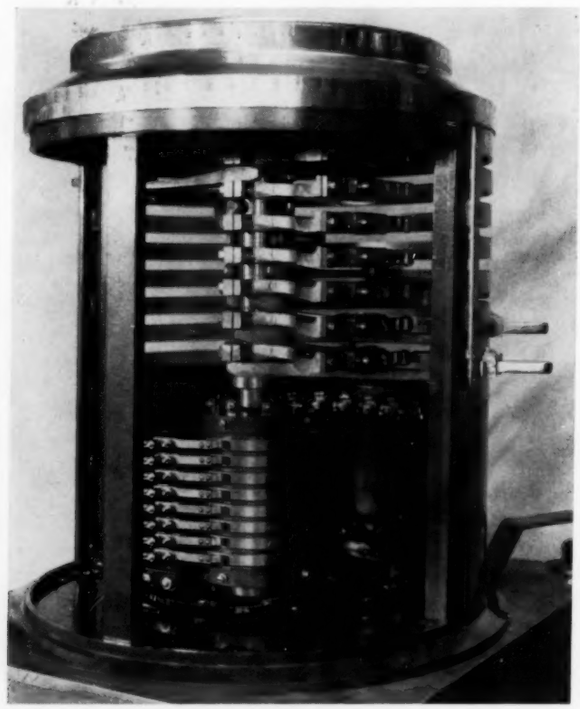


FIG. 8

These seven toggle switches on the lower left panel are used to select whether or not the motor

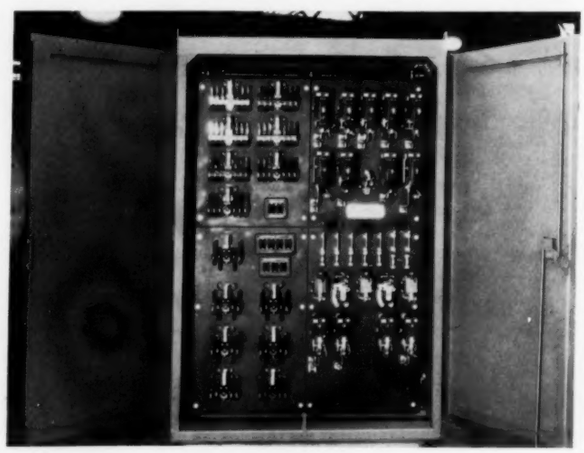


FIG. 9

accelerates to full speed. If any pass movement is short it is the usual practice to leave that selector switch open. The movement then occurs with armature resistance at a slower speed. These two toggle switches on the upper left panel dictate whether Pass 3 and 5 movements shall be up or down de-

pending on whether matching is done on the third or fifth pass or not at all.

The remaining units are various sequence relays and contactors for the synchronous tie and a regular reversing and plugging controller with two steps of dynamic braking for the screwdown motor.

To summarize I wish to say that we do not believe there is any one type of automatic screwdown control that is universally applicable. Each application needs different features. For the beam mill automatic screwdowns we had to sacrifice simplicity for accuracy and speed. For the three high mill we do not need so much accuracy but we do need simplicity and flexibility. I am very sure the future will find many more applications between these two limits.

In Memoriam

It is with the deepest regret that the Association announces to its membership the death on June 18, of William T. Snyder, Manager of Industrial Relations, National Tube Company, McKeesport, Pa.

Born in Alpsville, Pa., 1880, Mr. Snyder spent his entire steel mill career of forty years at the McKeesport plant of the National Tube Company. Over this span of service he successfully filled the positions of superintendent of electrical and power departments, superintendent of construction, and at the time of his death was the manager of industrial relations.

Those of us who were intimately acquainted with his work in the A. I. & S. E. E. know only too well of his many constructive contributions. Joining the society in 1909, Mr. Snyder immediately took an active interest in all of its activities. In 1916 he was elected the president after serving as chairman of many committees. Conscious of the necessity for the association to enlarge its scope of activities, he worked unceasingly and it was largely through his efforts that the groundwork was laid upon which it has been possible for the association to grow into such a useful agency to the steel industry.

WILLIAM T. SNYDER

Through all the years of his affiliation with our group he maintained his active interest and at the time of his death was chairman of the advisory committee.

His loss will be keenly felt by the industry he served and the association for which he diligently labored. At this time we wish to extend deepest sympathy to the family and friends of W. T. Snyder who commanded the highest respect as a gentleman and co-worker.

ELECTRIC CONTROLLERS FOR THREE-HIGH SHEET ROUGHING MILL SCREWDOWNS

By J. J. MELLON
Clark Controller Company, Cleveland, Ohio

Paper presented before the Chicago District Section of the A. I. & S. E. E., March, 1935.

The increasing use of various types of automatic screwdowns on 3-high sheet roughing mills has led to much study and development on electric controllers for this application. Due to the limited time allotted for this discussion, only the main features of certain types of controllers will be discussed.

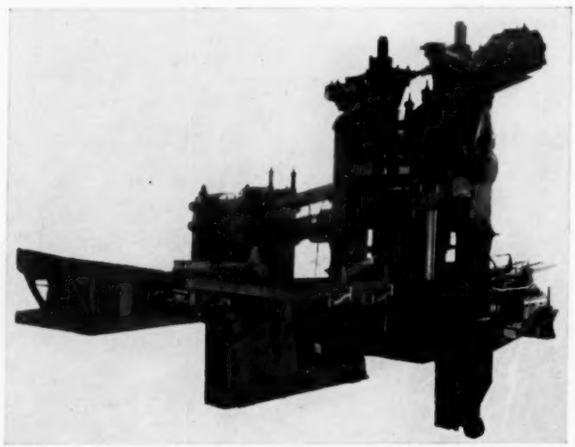


FIG. 1

On a recent installation, the consulting engineers outlined a set of requirements, which were beyond anything done along this line in the past and the meeting of these requirements has further accelerated this development. In view of the fact that this application of automatic screwdowns to mills of this type is relatively recent, it is felt that the reasons for going to this type of equipment will be of interest as well as a brief description of the final apparatus.

It was required that the mill mentioned above be able to roll 1,800 pair or 82.87 gross tons of bar weight per eight-hour turn rolling from 12″x37½″ bars weighing 103.125 lbs. per pair to 70″ long. This, of course, means that an average of one pair of bars every sixteen seconds must be rolled.

The requirements called for rolling the above schedule in two single and three matched passes or a total of five passes.

A study of existing installations showed that nothing like this was being done and a development was started to make these requirements possible. The motor drive on the screwdowns was first investigated. On early installations of screwdowns of this type, a 10 H. P. mill type motor had been used but this had to be replaced by a 15 H. P. motor because of torque requirements. A time study of the operations of this screwdown with the 15 H. P. motor showed that it was not fast enough to meet the requirements, particularly on the long movement in setting up for the first pass.

The use of a larger motor was considered but it was found that the increased WR^2 of the larger motor minimized the effect of the additional horsepower and sufficient speeding up of the operation could not be obtained.

A study of the proposed schedules showed that the screw movements in the down direction were relatively short and in the up direction relatively long. This, of course, suggested the use of two motors connected in series in movements in the down direction, and in parallel in upward movements.

Calculations showed that two 15 H. P. mill motors with necessary gear ratio changes would speed up the screwdown operation to meet the requirements.

To minimize the WR^2 of the drive, special low inertia brake wheels were used on the two 14″ series

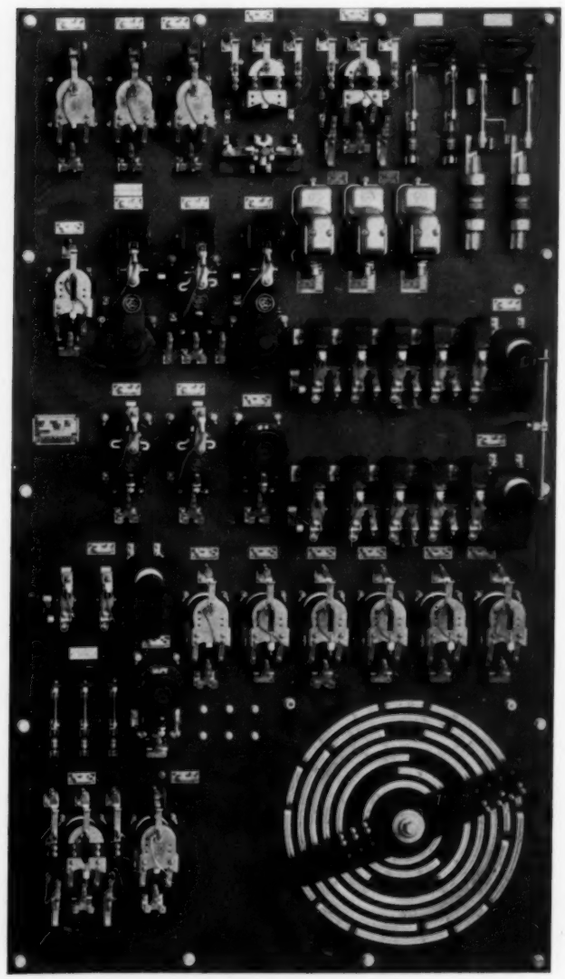


FIG. 2

wound brakes on the motors. The entire mechanical drive was then designed with a view of minimizing the inertia.

The use of compound wound mill type motors was decided upon so that dynamic braking could be easily secured to assist the magnetic brakes in stopping.

On some screwdowns of this type, provision is made for leveling the rolls by a hand wheel mounted

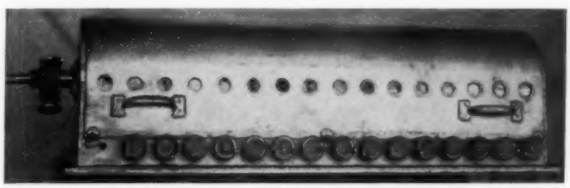


FIG. 3

on the housing at a point accessible to the operator. This leveling is entirely mechanical. Other mill builders have used a magnetic clutch between the two motors which can be disengaged to obtain relative movements of the screws when leveling the rolls.

Figure 1 shows a 3-high mill with two-motor screwdown and hand wheel for leveling the screws. This is a factory picture and of course on an actual installation much of the equipment shown will be below the floor line.

Considering the control for this application, the first thing that is apparent is that the control must be extremely simple. The rollers, who are not electrical men, must be able to adjust the screwdown for schedule changes, variations in mill conditions, and substitutions of rolls of turned down diameters. There are many other reasons for this but one does not have to give reasons for making a thing simple to steel mill men but in my experience he better have good excuses if he cannot make it simple. Taking into account what this screwdown controller does, the equipment described herein is very simple. Figure 2 shows the control panel for this screwdown. When it is understood that this panel controls two motors in series parallel control and for reversing dynamic braking service, it will be seen that there is not much additional complication due to the automatic features provided.

As is characteristic of all automatic screwdowns, it is necessary to have some sort of a limit switch, whose motion is synchronized with the screwdown drive. On this application in addition it is necessary that it be possible for the operator to adjust the pass settings during rolling due to varying mill conditions. Therefore a limit switch of such shape and character was developed that it could be mounted on the mill housing near the operator and driven directly from the screwdown drive.

On the left hand side of the housing as shown in Figure 1, the limit switch for this type of screwdown is shown. The direct drive shaft of the screwdown mechanism to the limit switch is shown in the picture. This limit switch could just as well have been mounted remotely and operated by a power Selsyn drive but inasmuch as this is the correct place for the limit switch anyway, this additional complication was not required.

Figure 3 gives a better view of this type of limit switch although the limit switch shown in this picture is arranged for a very large number of passes. It will be noted that a micrometer adjusting hand wheel and a dial is provided for each pass. In setting up the schedule, the operator merely sets up the indicating dials by manipulating the hand wheels until the reading checks with the desired schedule. After the dials are set up for a given schedule, the operator merely continues to depress the same button momentarily, every time the end of a piece goes through and the screwdown is automatically set up for the next pass. In order to prevent the operator from jamming the rolls due to improper dial setting, an upper and lower limit dial is provided which may

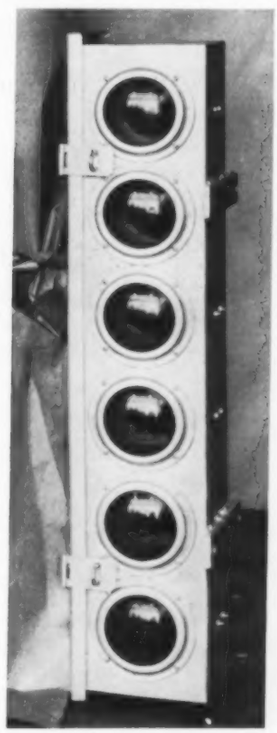


FIG. 4

be locked into position and can only be moved by responsible parties. These two extra hand wheels practically lock the operation of the screwdown between the minimum level that the operator should ever go and the maximum upper level to which he has to go to roll any of the schedules that are rolled on that mill.

An indicating light system is provided which is visible from both sides of the mill and on the lenses the number of passes are written up. Figure 4 shows such a device. The lenses on this device are about the same size os an ordinary traffic signal light and it informs the operator what pass the screw is set up for at any time.

When roll changes are made and rolls of different diameter put in, it is only necessary to adjust the general correction hand wheel mounted above the limit switch and this automatically corrects for variation in roll diameter without effecting the dial cali-

bration. At any time during the rolling operation adjustment to any and all passes may be made by the operator by merely adjusting the individual hand wheel effected.

Tests on this screwdown show that the screwdown is practically always ready and waiting for the material when the mechanical feeding devices are ready to put the material in the rolls.

On a 3-high mill if the operator should forget to set the screwdown for the first pass and if he should try to enter bars with the screws set for some intermediate pass, roll breakage or "gagging" might occur. This screwdown equipment is so interlocked with the mechanical feeding equipment so that the feeding equipment will not feed material to the rolls on the first pass unless the screwdown is set for pass No. 1.

A further interlock of the feeding devices and the screwdown prevents material ever being fed to the rolls so that material can be in the top and bottom pass at the same time.

On the automatic tables for these three 3-high mills a further interlock is provided which prevents the roller table feeding material into the mill unless the catcher table is in the down position ready to receive it. Since the catcher table is tilted and the chains reversed by an operator on the catcher side, this interlock is important since it prevents bars coming through the mill and falling down under the table.

The automatic feeding equipment for bringing this material to and from the mill is not within the scope of this paper but it might be stated that they were so worked out that the schedule as orginially outlined by the consulting engineers will apparently be fulfilled in the very near future. Combination tests have already been made on this and they verify this statement. If desired in the discussion the writer will be very glad to outline roughly the complete sequential operation of the entire equipment to produce the tonnage specified.

The above mentioned type of screwdown works out very well on mills where the number of passes are practically always the same and where matching takes place always on the same pass. On many jobbing mills, it is desirable to be able to change both the number of passes and the passes on which matching takes place very freely without unnecessarily complicating the scheme by involved transfer means. A recent screwdown on this general type has been built which is arranged for either three, five or seven passes and for matching on any pass in the cycle. Fundamentally, the scheme is the same as outlined above, except for the operating means. The operating means, instead of being one push button, is two push buttons, two foot switches or one reversing spring return master switch. The dials are marked for either up or down movement. In rolling a pair of bars there are only two times in the cycle, regardless of the number of passes, in which the screws move upward. The first time is preparatory to matching and the next time is in preparation for entering the bars on the first pass.

For instance, on a seven pass cycle with matching after the third pass, the operator would depress the "Down" push button station after the material had gone through pass No. 1 to set up for pass No. 2, and after it has gone through pass No. 2, to set up for pass No. 3, but after pass No. 3 he would depress the "Up" push button station set up for pass No. 4, which is the first pass after matching. On the next two passes the operator would again depress the "Down" push button station for passes five, six and seven, and then the "Up" push button station for the first pass. In other words, this is to be just like a master switch control, magnetic screwdown controller, except that the stopping at the right position would be automatic.

When changing to a three or five pass schedule, it would only be necessary to set up the dials in line with the schedule required and after three or five passes, of course the "Up" push button station would be depressed and that would automatically cancel the last two or four down motions that would have been used on the seven pass schedule.

With the indicating light system, it is extremely easy for an operator to see just what pass he is on.

It might be said here that the same movement which sets the screwdown is also used to actuate the material handling devices used in conjunction with this mill so that the operator really is not very busy.

On the five pass mill described above, all the roller has to do in ordinary operation is momentarily depress the push button station every time he sees the end of the material go through the rolls or come through the rolls.

The man on the catcher side has the master switch which automatically tilts the table and changes the direction of the chains when he operates it in one direction and does the reverse when he operates it in the opposite direction. In addition to this, of course, this operator has some hand operated stops to operate. I will be very glad to review any of these points and go over any of the feeding equipment used on this installation in the discussion.

SCREWDOWN CONTROL

By F. J. BURD
Cutler-Hammer, Inc., Chicago, Ill.

Paper presented before the Chicago District Section of the A. I. & S. E. E., March, 1935.

I will briefly illustrate screwdown controls for single stand, 4-high cold mills and multiple stands of continuous hot strip mills. These are semi-automatic controls in that the starting impulse is by means of push button or masters, but the stopping can be by limit switches or definite time cut off. About 100 of these controls have been installed during the past four years.

A tandem drive is used on these screwdowns so that either side of the roll can be lowered or raised without disturbing the other. However, both sides of the roll can be raised or lowered simultaneously.

The various combinations of tandem drives are:

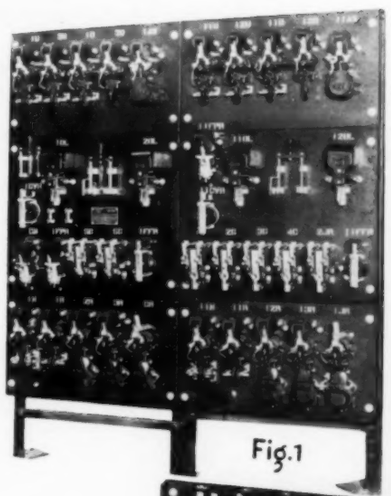


Fig. 1

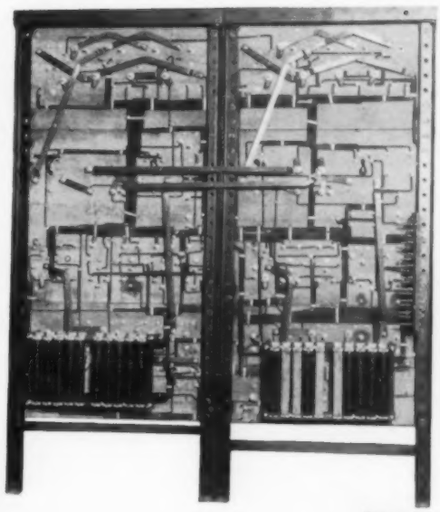


Fig. 2

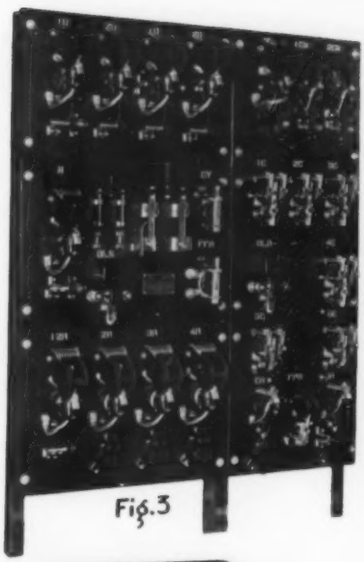


Fig. 3

Fig. 4

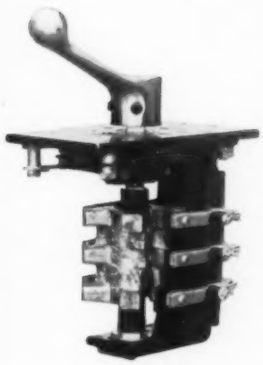


Fig. 5

Fig. 6

2 motors with a magnet closed clutch between them.

2 motors with a spring closed clutch between them.

1 motor with two magnet closed clutches between them.

1 motor with two spring closed clutches between them.

Separate push buttons or small masters are provided for selecting the desired operation. A preadjusted movement of the roll occurs on each impulse from the masters or buttons which must be released before repeating the impulse.

The control automatically separates the tandem drive or securely ties both ends together as required by the desired operation. Positive electrical interlocking insures complete separation of the tandem drive or keeps it locked together through a complete cycle.

Figure 1 illustrates a control for two 15 H.P. motors and a spring closed clutch on a Steckel mill screwdown. This control has a timed cut off for automatically stopping the motors after moving the screwdown a short pre-determined distance. The timed impulse can be repeated by releasing and repressing the jog buttons. Longer travels are obtained from a separate master switch.

Figure 2 illustrates a rear view of the above control.

Figure 3 shows a control for one 75 H.P. motor and two magnet closed clutches. This arrangement permits utilizing the full power of one large motor to either side of the roll. Jogging with timed cut off features are also included in this control.

Figure 4 shows a control for two 60 H.P. motors and one magnet closed clutch. This is a master controlled job from two benchboards. Three masters are on each benchboard for operating either motor independently or both tied together with the clutch.

Any of the six masters can take control when the motors are not running, regardless of the position of the others. When any master has the control, the others are nullified.

Figure 5 shows the benchboard type master referred to above.

Figure 6 shows a control and resistance in a dust-tight steel cabinet for two 10 H.P. motors and one magnet closed clutch.

AUTOMATIC PRESET SCREWDOWN CONTROL

By W. M. BALLENGER
General Electric Company, Chicago, Ill.

Paper presented before the Chicago District Section of the A. I. & S. E. E., March, 1935.

The purpose of automatic preset screwdown control is three-fold:

(1) To increase the mill tonnage by more quickly changing the roll settings between passes.

(2) To improve the quality and uniformity of the product by rolling down to finished size in a predetermined number of passes and in accordance with a definite reduction per pass previously determined by calculations and experience.

(3) To permit the operator to devote more time and energy attending other duties incidental to rolling. In some cases it might be possible to actually eliminate one operator.

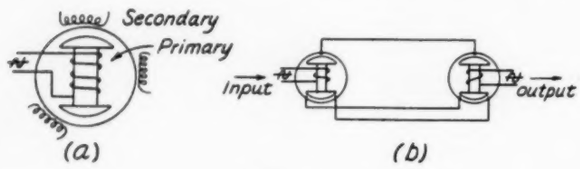


FIG. 1

Advantages of the particular form of preset screwdown control described are:

(1) Accuracy
(2) Simplicity
(3) Flexibility
(4) Ease of making a program set up
(5) Rapidity with which program may be changed
(6) No differential gears.

The exact scheme of preset control, whether automatic, semi-automatic, or otherwise, depends entirely upon the type of mill and the diversity of products to be rolled, and careful consideration must be given each specific case. Naturally, a jobbing blooming mill with widely varying schedules every few ingots would not lend itself readily to fully automatic preset control.

The form of preset screwdown control developed by the General Electric Company consists of a few simple standard elements, as follows:

(1) Compound wound mill type motor (or motors as the case may be) with brakes.
(2) Reversing, plugging, dynamic braking magnetic control panel with adequate slow-down features.
(3) Selsyns.
(4) Thyratrons.
(5) Selector switch, manual master switch, etc.

Let us first consider the theory of operation of the main control elements individually and then gradually build up the control system out of these elements.

Figure 1a shows a selsyn instrument, a selsyn being a trade name devised from the words "self-synchronizing." In appearance the selsyn looks like a small fractional-horsepower motor with two collector rings. In principle, the selsyn is nothing more than a single-phase transformer with one primary and three secondaries. The primary can be rotated so that its "coupling" can be changed with respect to each of its secondaries. The amount of voltage induced in each secondard depends upon the relative position of the rotor. Actually, the secondary is a distributed winding identical with a three-phase "Y" winding having the neutral made inside the machine.

If another identical selsyn unit has its secondary, or stator, connected to the first Figure 1b, then a single-phase transformer system is obtained. A single-phase alternating-current voltage of varying magnitude may be obtained as the two rotors are displaced relative to each other. Neglecting transformation losses and line drop between the two units, the voltage at the rings of the second machine will be of the same magnitude as the input when the two rotors are in the same physical position. The voltage output will decrease as the rotors are displaced until they are 90° apart, then there is zero voltage output. As the displacement is further increased, the voltage reverses in phase and reaches a maximum at 180°. The tabulation shows voltage versus displacement.

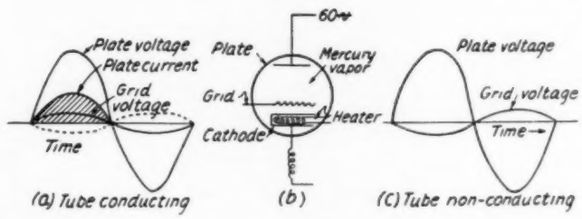


FIG. 2

Displacement Degrees	Voltage output relative to input (110 volts)
0	+110
90	0
180	−110
270	0

The variation is gradual between these points and has the form of a sine wave with respect to displacement.

Thus is provided a means of transmitting and regulating a voltage at a distance. No mechanical torque is transmitted between the two selsyns and the magnitude of the voltage depends only upon displacement. The time phase is the same as the input voltage, regardless of position, voltage drop neglected.

The next essential element is a thyratron tube, Figure 2b which is a hot cathode mercury vapor, grid controlled rectifier. Here it is used purely as a relay as its characteristics permit it to function on very little power; however, it is capable of delivering amperes instead of micro amperes or milliamperes as in a more perfectly evacuated tube. The starting of the current flow is controlled by the grid potential. When the grid has a sufficient negative potential with respect to the cathode Figure 2c, the tube will not pass current. Should this grid potential become slightly positive (or less negative) beyond a certain critical value, the tube conducts as long as

the plate potential remains positive as in Figure 2a. With alternating current applied to the tube it will pass current only when the plate is positive. When the plate is negative, no current is passed.

Thus is obtained a convenient form of relay. By imposing on its grid a few volts of the same phase as the plate, the tube will pass direct current. This direct current can be used to actuate the coil of a contactor, there being half wave rectification.

Let us now connect the two selsyn units and the two thyratrons together Figure 3 in such a manner as to form a simple follow-up system. Suppose it is desired to make the screw-down motor follow a remotely located selsyn unit which is operated by hand. The follow-up selsyn is attached to the screwdown motor. With the rotors in the position as shown, no voltage appears on the rings of the follow-up selsyn. Turning the controlling selsyn by hand produces an angular displacement between the two, and when the displacement reaches one or two degrees, sufficient voltage appears at the follow-up selsyn rings to cause one thyratron to pass current, which in turn actuates the magnetic control of the screwdown motor. The screwdown motor starts and continues running until the angular displacement is wiped out. When this happens, the thyratron ceases to pass current, thus shutting down the screwdown motor. By using two thyratron relays, both forward and reverse operation can be obtained, depending upon whether the displacement is clockwise or counter-clockwise.

This is done by taking the voltage output of the follow-up selsyn and impressing it upon the grids of two thyratrons in such a way that when one grid is made positive, the other is made negative.

In this manner is established a simple follow-up system. It should be remembered that the movement of the controlling selsyn involves a torque only sufficient to overcome its own friction. No torque is transmitted.

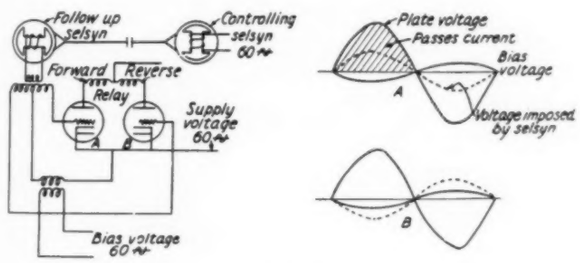


FIG. 3

The next step is to provide a number of these controlling selsyns, or preset selsyns, one for each pass of the schedule and arrange the selector switch control so that first one and then another controlling selsyn is connected to the follow-up selsyn by suitable contactors Figure 4.

There are certain limitations in this simple system. It will be noted that if the controlling selsyn is displaced more than 180° from the follow-up selsyn and then their secondaries are connected together, the follow-up selsyn will "take the shortest way home." Therefore, the follow-up selsyn must be geared so that full spread of the rolls will not rotate the selsyn more than 180°.

It is possible to arrange the voltage output of the selsyn unit so that a neutral of one or two degrees is obtained. That is, the selsyn motors must be displaced one or two degrees with respect to each other before sufficient voltage appears to trip the thyratron relays. If the system is limited to an accuracy of 1 degree in 180, the accuracy is 1/180. If the maximium roll opening is 50 inches, the accuracy is ± .28 inch. Obviously, this is not close enough and some vernier scheme must be added to improve accuracy. Further, if the screwdown motor should come into correspondence at full speed, it is almost certain to overshoot and reverse.

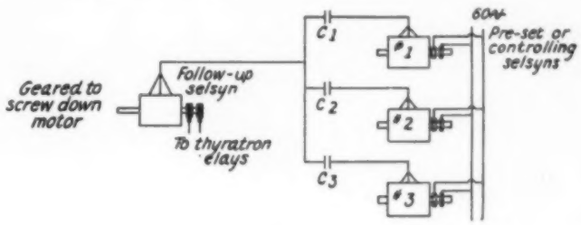


FIG. 4

To accomplish these ends, a double selsyn system is used. To the follow-up selsyn and also to each of the controlling selsyns, an additional selsyn is geared with such a ratio that one degree rotation on the coarse selsyn gives 20 degrees on the vernier selsyn. A second set of thyratrons is, of course, required for the vernier adjustment, making a total of four thyratrons.

The coarse selsyns act only to bring the system into approximate correspondence at full speed, while the vernier selsyns act to bring the system into exact correspondence under shunted armature connections on the motor.

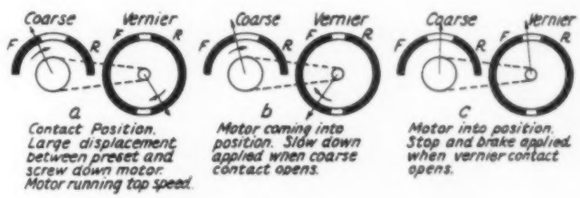

Coarse
Vernier
F
R
a
Contact Position. Large displacement between preset and screw down motor. Motor running top speed.
b
Motor coming into position. Slow down applied when coarse contact opens.
c
Motor into position. Stop and brake applied when vernier contact opens.

FIG. 5

Even with the vernier neutral as much as two degrees, on the basis of a 50-inch roll opening, the accuracy is ± .028 inch, or 1/10 of 1 per cent. Actually, in practice, the system will repeat much closer when approaching the setting from the same direction as the motion coasts about the same amount each time.

A mechanical analogy will make this clearer Figure 5. Assume that the contact arms are driven by the screwdown motor, through the proper gear ratio, and the contact segments are driven by the preset mechanism. If the contact segments are rotated as shown at the left with respect to the contact arms, the necessary contactors are actuated to cause the screwdown motor to follow. With the contacts in position as shown at the left, the screwdown motor is running at full speed. As shown in the center, the motor has decelerated down to 20% speed and is running under shunted armature. With

the contacts as shown at the right, the motor is stopped under braking action.

Figure 6 shows diagrammatically the equipment required for an 11-pass maximum schedule. The controlling selsyns are mounted on a panel located in the pulpit. By means of some arrangement similar to a telephone dial, the necessary settings are made.

The pass selector can be either a multi-position switch or a ratchet notching device equipped with a Veeder Root counter.

The manual master switch takes control away from the automatic system at any time it is manipulated.

For a universal slabbing mill or a structural mill, a separate preset panel is required for the vertical roll motor and an independent set-up is made for it. However, the controlling selsyns for both horizontal and vertical roll adjustments are simultaneously actuated through multi-pole contactors.

The rapidity with which a new roll setting can be effected depends upon the screwdown mechanism, gear ratio, etc. Considerable time should be saved by automatic control because the rolls are moved to their new positions without the waste of time associated with the term "spotting the rolls" by the usual hand control.

For jobbing, blooming and slabbing mills where it is not deemed advisable to use automatic preset control on account of frequent changes in rolling schedules, semi-automatic control may be used. This consists of a single controlling and follow-up selsyn combination. This simple arrangement permits the operator to set up the next pass opening on the controlling selsyn (equipped with a handwheel and dial) while rolling any particular pass. Just as the metal leaves the mill, the operator pushes a button and the rolls assume a position as determined by the setting of the controlling selsyn.

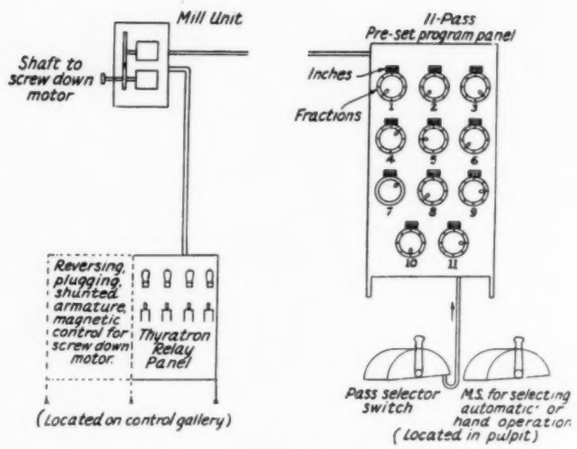


FIG. 6

On mills such as cold strip mills where screw pressures are tremendous and where the "spring" of the mill housings is a decidedly influencing factor in successfully rolling down to gauge, a type of automatic control using electro-limit gauges is best suited. Depending upon the width of the strip, one or two electro-limit gauges can be arranged to automatically raise and lower the screws so as to maintain gauge. Such a system must have sufficient damping to prevent adjusting the screws for each small "hill and valley" in the strip.

ITEMS OF INTEREST

The Amsler-Morton Company announce the addition of Karl W. Gass as chief engineer. Before his association with the Amsler-Morton Company, Mr.

KARL W. GASS

Gass had been actively engaged with several engineering companies in various capacities as follows: 1912 to 1915 with United Pump and Power Company; 1915-1916 with Chester & Fleming, consulting engineers; 1916 to 1935 with Fort Pitt Engineering Company.

▲

The Carnegie Steel Company announce the appointment of Howard Linn to the superintendency of its new hot strip mill under construction at McDonald, Ohio. A graduate of the University of Pittsburgh, Mr. Linn had been associated with the Superior Steel Company, Carnegie, Pa., and the Weirton Steel Company before accepting his new position with Carnegie Steel Company.

▲

The American Bridge Company announce the appointment of Albert Reichmann, former assistant chief engineer, as vice president with offices at Chicago.

▲

O. E. Romig, formerly metallurgist, Gary Sheet Mill, American Sheet and Tin Plate Company, Gary, Indiana, has been appointed manager of electrical sheet division, American Sheet and Tin Plate Company, general offices, Frick Building, Pittsburgh, Pa.

▲

James P. Barton has been appointed sales engineer, electrical sheet division, American Sheet and Tin Plate Company, Frick Building, Pittsburgh, Pa., formerly being associated in a similar capacity with

the Empire Sheet and Tin Plate Company, Mansfield, Ohio.

▲

On June 1, 1935, Mr. Frank F. Holstein joined the lubrication and engineering service data department of The Hodson Corporation, Chicago, Ill., lubrication engineers and manufacturers. He will also handle the advertising for this company. Mr. Holstein studied advertising art at the Art Institute of Chicago and received his bachelor of arts degree at the Illinois State University. He was formerly connected with the Buchen Advertising Company of Chicago.

▲

Colonel L. Joly, well known engineer in automatic control, is now associated with Fred S. Bloom, 916 Behand street, North Side, Pittsburgh, Pa., in the sale of Askania Automatic Control within the Pittsburgh territory, for H. A. Brassert & Company.

▲

The Chicago Section held their twelfth annual spring golf tournament on June 4 at Navajo Fields Country Club. Over one hundred twenty were in attendance, and although a few drops of rain fell in the afternoon, nothing could dampen the "spirits" of these golfers.

A. J. WHITCOMB, (Freyn Eng. Co.) thinks he can't miss.

GEORGE E. ROSE, (Wisconsin Steel Works, Int. Harv. Co.) sinks a long one.

R. O. HERBIG, (Reliance Electric & Eng. Co.) and "Calamity Jane" were able to sink this one.

Left to right: K. E. DINIUS, (Illinois Steel Co.); GEORGE HENRY (General Electric Co.); O. M. BERCAW, (I. T. E. Circuit Breaker Co.); T. E. BEASELEY, (Clark Controller Co.); HENRY DAVIS, (Rep. Steel Corporation); sitting: C. J. SMITH, (Illinois Steel Co.)

Navajo Fields Country Club has a beautiful 18-hole course with many well-placed hazards and bunkers, to say nothing of a creek that winds through seven or eight holes of the course, which was of no assistance whatever to the majority of the players.

Many and loud were the alibis heard in the club house in the late afternon about the effects of showers, high cross winds, sun, terrain, and the like upon the individual golfer's score, for strange to relate the high gross score was 163 and the low gross was 88. Although a total of one hundred eleven played around the course, only fifteen were able to break a hundred.

However, there was one outstanding event. A hole in one was made by N. R. Kirkdoffer of the Inland Steel Company. Mr. Kirkdoffer made his hole in one on the twelfth hole which is a par three, 182-yard hole. This event was attested by the rest of Mr. Kirkdoffer's foursome and made the sports pages of all Chicago newspapers.

Forty-two prizes were donated by the various manufacturers. The distribution of these prizes was determined by net scores. Individual handicaps were based on nine holes (selected by lot) from the player's afternoon round.

▲

The Farrel-Birmingham Company, Inc., Ansonia, Conn., announces the addition of Walter L. Tann to its engineering department.

To his new post Mr. Tann brings a diversified experience in various phases of mechanical engineering and industrial management, acquired in several lines, particularly on heavy hoisting material handling and hydraulic machinery.

▲

After 34 years of continuous service, one of our members, Mr. Thomas W. Dana, retired only July 1, 1935, from active service with Carnegie Steel Company, Pittsburgh, Pa.

▲

J. W. Barnett, recently director of the division of construction and finance of the U. S. Shipping Board, will, on July 1, join The Babcock & Wilcox Company's marine department.

▲

A. J. Wadhams, manager, development and research The International Nickel Company, Inc., has announced the addition of Harold L. Geiger to the field staff of that department.

Mr. Geiger's experience has been with the operating and metallurgical departments of the Inland Steel Company and since 1929 as chief metallurgist of the Wisconsin Steel Company—a subsidiary of International Harvester.

▲

The Rollway Bearing Company of Syracuse, New York, announces that it has appointed Mr. Fred W. Kulicke Philadelphia representative, taking the place of Mr. John W. Firmin, who died recently.

Mr. Kulicke has had extensive experience in both sales and engineering work with E. G. Budd Mfg. Company, Eclipse Machine Company, Baldwin Locomotive, Hess Bright Ball Bearing Company and others.

▲

The Timken Steel & Tube Company announces the appointment of Mr. S. D. Williams as manager of tube sales with headquarters at Canton, Ohio. Mr.

Williams has been connected with the steel industry since graduating from Lehigh University as a metallurgical engineer in 1913. He started work with the Carnegie Steel Company at Homestead, subsequently becoming superintendent of open hearth operations for the Central Iron & Steel Company, at Harrisburg, Pa. Later he became associated with the Pittsburgh Crucible Steel Company, Midland, Pa, as chief metallurgist, and in 1926 joined The Timken Steel & Tube Company as metallurgical sales engineer, being made assistant director of sales in 1932, which position he filled until his recent promotion.

▲

Known for its pioneer work in the field of porcelain enamel on steel Ferro Enamel Corp., Cleveland, announces opening of two foreign subsidaries at Sao Paulo, Brazil, and Melbourne, Australia. The company already has foreign plants in Holland, England, France and Canada. President R. A. Weaver is now touring these foreign subsidiaries.

C. D. Clawson, export manager, who has lived in a steel-porcelain enamel home, leaves Cleveland to become managing director in South America.

▲

The retirement of John G. Barry, senior vice president of the General Electric Company, after more than 45 years of service, and his election to an honorary vice presidency, was announced by President Gerard Swope following the meeting of the board of directors held in New York on June 28. Mr. Barry, as active head of the apparatus sales organization, has for many years formulated and executed the company's policy and sales program in the apparatus field. He will maintain an office in Schenectady and will be available for consultation. The retirement is effective as of July 1.

▲

Ground was broken for the three and one-half million dollar extension to the East Works plant of The American Rolling Mill Company recently. George M. Verity, chairman of the board, turned the first spade full of earth with the same silver spade that was used in breaking ground for the East Works plant in March, 1910. This spade was borrowed from Mrs. V. C. Hatfield, as it was presented to the late Judge Hatfield at the time it was first used in recognition of his helpful co-operation. In breaking ground for the new extension which will maintain the reputation of Armco's East Works plant as the most outstanding sheet steel plant in the country, Mr. Verity said: "On March 10, 1910, I turned the first spade full of earth on the site of the East Side Works marked a new era in the history of Armco. East Works was originally planned to produce from 12,000 to 14,000 tons of ingot per month. I understand that the open hearths have recently produced as much as 58,000 tons of ingots in a month and we will have a potential capacity of from 60,000 to 65,000 tons in the near future.

"The cost of this new cold strip finishing unit will be approximately as much as that of the entire construction program of the original East Works in 1910. We are building a new unit requiring mammoth machinery and much of technical processing to enable us to take advantage of the latest and most approved methods of making high-grade sheets. We hope and believe that this new development in Middletown marks the beginning of a new era of progress for Armco and for Middletown as a community. This important action taken in these troublesome times proves our company's faith in the future of the nation and of the steel industry, and it expresses our pardonable pride in the accomplishments of the past. We have sincere confidence in the ability of our East Works organization to complete the difficult task successfully and to carry on in the future just as effectively as it has in the past."

L. F. Reinartz, works manager; J. B. Tytus, vice president of Armco, and F. H. McGraw, president of the McGraw Construction Company, made brief talks.

A working force of approximately 150 men will be required to operate the new mill when it is completed, while 150 to 200 men will be employed on the construction work.

WITH THE MANUFACTURERS

▲

A newly designed general purpose magnetic clutch, with a number of important improvements is announced by Cutler-Hammer, Inc., Milwaukee, Wis. Bulletin 522, which describes these new features in detail, will gladly be sent on request by the manufacturer.

▲

The Aluminum Company of America, Pittsburgh, Pa., announce the release of a completely revised edition of the booklet, "Alcoa Aluminum and Its Alloys." The company wishes to announce that it is the most comprehensive booklet on aluminum that it has for distribution.

▲

The General Electric Company, Schenectady, N. Y., announce the availability of booklet on Pyranol Capacitors and Cable Compounds.

▲

SKF Industries, Inc., Philadelphia, has covered a wide scope of bearing information in its 76-page edition of engineering data sheets just off the press.

Subjects include index of bearing types; selection, mountings and lubrication of ball and roller bearings; self-aligning ball bearings; single row ball bearings; double row ball bearings; spherical roller bearings; cylindrical roller bearings; ball thrust bearings; conversion tables; transmission appliances; district offices; and tables showing principal dimensions, shaft fits and tolerances, housing fits and tolerances, removable sleeves, shaft locknuts and lockwashers, corner radii and shaft fillets.

▲

Electrical Engineers Equipment Company, Melrose Park, Ill., just published a new condensed catalog containing up-to-date price information on cable end bells; disconnecting switches; bus and cable supports, etc. A copy of this condensed catalog will be sent to anyone upon request.

▲

The Norma-Hoffmann Bearings Corporation of Stamford, Conn., announces that its "GreaSeal" line of Felt-Protected Precision Ball Bearings has been

extended to include three larger sizes—40, 45 and 50 millimeter bore. The "GreaSeal" line includes three series: "7000," with single felt seal; "7000-P," with single felt seal and plate shield; and "77000," with double felt seal. The two latter series are fully enclosed, for retention of lubricant and exclusion of dirt and moisture. All three of these "GreaSeal" types are self-contained units distinguished by the removable felt seal consisting of thick, closely-fitting felts between removable plates—forming an effective labyrinth against the recessed inner ring. The felt seal, being completely within the confines of both rings, is not exposed to injury. The wide, solid inner and outer rings make inserts in the housing unnecessary, and safeguard against looseness, slippage, and escape of lubricant past the outer ring. The seal construction is such that all distortion of the ball races is avoided. This, with extreme precision, makes for quiet running. The grease capacity in all three "GreaSeal" types is ample for long periods of service, without renewal.

▲

An order amounting to approximately $1,000,000 has been awarded to the Westinghouse Electric and Manufacturing Company for motors, power supply and control units, and other electrical equipment by the Great Lakes Steel Corporation for new wide hot and cold strip mills in Detroit. Large size electrical units, in the order, include eight 1250 horsepower direct current motors and four 6000 kilowatt motor-generator sets.

The motor and control equipment for a new 42-inch reversible cold strip mill of the Republic Steel Company at Warren, Ohio, has also been awarded to the company. Amounting to approximately $100,000, the order includes a 1200 horsepower mill motor and two 300 horsepower reel motors.

▲

A new industrial thermometer catalog has just been issued by the C. J. Tagliabue Manufacturing Company, of Brooklyn, N. Y. The catalog (No. 1125) contains 24 pages of conveniently arranged listings of the complete Tag line of industrial thermometers, miscellaneous metal and woodback thermometers, hygrometers, U gages, mercurial vacuum gages and mercurial barometers. The company will be glad to send a copy of this valuable catalog free on request.

▲

The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has placed on the market the "Synchro-Operator," an automatic control device which eliminates all human element and performs rapidly the combined functions of speed matching, synchronizing and visual phase angle indicating; these formerly required, a frequency matcher, an automatic synchronizer and a synchro-scope. The "Synchro-Operator" is not much larger than the usual synchroscope and can be mounted on a swinging bracket.

It accurately synchronizes generator and bus even if there is a voltage difference and it is satisfactory for both stable and erratic frequencies. The control closing instant is advanced (at a phase angle proportional to the difference in frequency) to compensate for the inherent time lag in circuit breakers thus making the breaker close at the exact point of synchronism.

One "Synchro-Operator" will serve any number of generators and can be used in connection with existing governor control motors and station circuit breakers. It consumes little energy, operates through standard potential transformer metering circuits, requires no special features on prime mover or generator and contains no vacuum tubes.

▲

A newly patented magnetic clutch coupling insuring positive quick engagement and disengagement, with less than 1½ degrees of slip, is announced by the Dings Magnetic Separator Company, Milwaukee, Wis. This device has already found wide application on hot and cold strip mill secondary screwdown shafts, soaking pit covers and on many other applications where positive engagement and remote control is necessary or desired.

The Type SCC Clutch transmits unusually high torque, five times that of an ordinary friction type clutch of the same diameter and of either the single disc or multiple disc design.

▲

Combustion Engineering Company, Inc., 200 Madison avenue, New York, has just issued a bulletin describing its VM boiler which embodies a compact efficient design for medium-size and small plants, particularly where headroom is limited. Sizes range from 1359 to 6300 sq. ft. of heating surface and full information is given on all essential boiler and setting dimensions for the numerous sizes within this range. Blue print reproductions are included showing typical settings with underfeed chain and traveling grate stokers as well as with pulverized coal. Fusion welded drums are furnished regularly, with riveted drums optional.

▲

Appleton Electric Company, 1701-29 Wellington street, Chicago, Ill., announce a complete line of Appleton Industrial Reflectors and Flood Lights, listed in No. 802 Bulletin just off the press. Copies furnished on request.

▲

All of the capital stock of the Calumet Steel Company of Chicago Heights, Ill., has been purchased by Borg-Warner Corporation and now operates as a separate Borg-Warner subsidiary, it was announced recently. Roy C. Ingersoll is the new president of the Calumet Company. Mr. Ingersoll is a director of Borg-Warner Corporation and president of the Ingersoll Steel and Disc Company Division of Borg-Warner Corporation.

Mr. Ingersoll was chosen president of the Calumet Steel Company at a meeting of the board of directors Thursday, June 13. F. G. Carrel, formerly secretary of Calumet, was named vice president, and Mathew Keck was elected as secretary and treasurer.

Directors of the Calumet Steel Company are: R. C. Ingersoll, F. G. Carrel, S. L. Ingersoll, Frank Matthiessen and C. S. Davis.

ADVERTISING PAGES REMOVED

The Louis Allis Company, Milwaukee, Wis., has recently published a special bulletin dealing with the special characteristics and containing other important information regarding electric motors for centrifugals. A copy of this bulletin No. 601 will be sent with their compliments to anyone interested.

▲

A new type of Firecrete for casting light-weight refractory concrete on the job has just been announced by Johns-Manville. Known as L. W. (or Light-Weight) Firecrete, this new product is composed chiefly of high alumina clay calcined at high temperatures.

▲

Harbison-Walker Refractories Company, Pittsburgh, Pa., announce folders describing three types of high temperature bonding mortars—Thermolith (with a chrome ore base), Firebond (with a silica base), and Harwaco Bond (with a diaspore base). In addition, each folder contains a list of applications for which the bonding mortar described is suited and is being used with economy. Upon request, they will forward folders to those who are interested.

▲

The Delta Star Electric Company, Chicago, Illinois, have issued a new bulletin No. 35-B giving complete data on ratings, dimensions, operating mechanisms, phase spacing and insulator characteristics of hook operated and group operated diconnecting switches for rural line service up to and including 34.5 K. V. These switches conform to the latest NEMA Standards. Data is also included on steel mounting frames and cross arm hangers.

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Information of interest to fabricators and users of stainless steel is contained in a pamphlet entitled "Stainless Steels Treated with Columbium", just issued by Electro Metallurgical Company, 30 East 42nd Street, New York. The pamphlet shows how the addition of columbium to the austenitic type of stainless steel results in the elimination of intergranular corrosion. Comprehensive data are given on the physical properties and corrosion-resistance of columbium-treated steels. Of particular interest is the fact that these steels, when welded with columbium-treated welding rods, exhibit no susceptibility to grain-boundary deterioration in the "as welded" condition, so that full corrosion resistance is obtained without heat-treatment after welding.

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A new welding torch known as the Purox No. 35 General Duty Welding Torch has just been announced by The Linde Air Products Company, 30 East 42nd Street, New York, N. Y. In mechanical details this new piece of equipment embodies refinements in design and operation that make it outstanding among medium pressure torches. Constructed of extruded brass, Monel metal, and drawn copper, and with silver soldered tubes, this torch is rugged and can stand rough treatment. Its range of usefulness makes it equally adaptable to the lightest as well as the heaviest work to be found in any welding shop.

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The tenth edition of the New Departure Manufacturing Company's catalog is now available. Beside containing listing of new bearing types and new sizes of existing types, it contains many helpful features for engineers and designers and may be had by addressing the company at New Britain, Conn., and ask for booklet SN.

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Electric Machinery Manufacturing Company, Minneapolis, Minn., has just published a 24-page illustrated folder of the many installations they have in the industrial and related fields. This may be had on request.

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Bulletin 109 describing and illustrating the lifting magnets of the Ohio Electric Manufacturing Company has just been released by the company.

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An 80-page booklet, supplemented with list prices, on cable accessories may be had by addressing the General Electric Company, Schenectady, N. Y., which company has just made a very thorough study of this equipment.

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The Thompson Electric Company, Cleveland, O., announce a pamphlet describing the new model of Thompson Lamp Lowering Hanger.

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A new plate mill caster has been recently developed by the Mathews Conveyor Company, Ellwood City, Pa. This caster is swivel type using two ball bearings to support the vertical shank. The caster fork is cast steel and supports a 4" diameter ball bearing wheel on a ¾" axle.

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The third edition of the Timken Engineering Journal has just been issued by The Timken Roller Bearing Company, Canton, O. Copies may be secured without charge by engineers, designers, libraries and executives on request to the company or any district office. Requests should be made on company stationary, giving title or connection.

This 260-page Journal, which is a series of 8½x11" loose leaves, bound in a heavy three-ring binder with stiff covers, has a 22 section marginal tab index for ready reference as well as the customary detailed index sheet.

OBITUARIES

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The Association announces with deep regret the death of L. V. Day, maintenance engineer, American Steel Foundries, Chicago, who died June 18 after an illness of several weeks. Mr. Day had been an active member of our society for 14 years and an employee of the American Steel Foundries for the past 26 years.

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Frank H. Streine, recently appointed head of the Mackintosh-Hemphill's finishing machinery division, was fatally injured in an automobile accident at Zanesville, Ohio, June 15. Mr. Streine had been a prominent figure in the finishing machinery field for many years.